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O. P. BRYSCH, Editor **P. J. CHATTA, Assistant Editor**

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1. MANAGEMENT

Gas Industry Management

Wanted: A U.S. — Canada Treaty for Natural Gas. J. Davis. *Gas Age 124,* 27 (1959) Dec. 10 (8 pp.)

Economic forces cut the border and point in the direction of a continental system of producing and marketing natural gas, in the opinion of many experts. In November a Canadian-American committee of the National Planning Association in the U.S. and the Private Planning Association of Canada presented a statement that a treaty to facilitate and accelerate transborder flows of natural gas could pay large dividends for both countries. Increased trade depends on proving up national surpluses, which should be committed for export only in volumes that can be sustained for decades, says author who provided background material for the joint statement. Export prices must be left inviolate until initiating contracts and government permits have run their course. A treaty, he believes, would help greatly.

Economic Aspects of Producing Pipeline Gas, Using Lurgi Generators for Gasifying Bituminous Char. S. Katell, J. H. Faber and M. R. Constantine. *U.S. Bur. Mines Rep. Invest. 5547,* (11 pp.) (Washington: U.S. Dept. of the Interior, 1959.)

Estimated capital investment of $76,499,800 would be required for a plant designed to produce 90 MMSCF/day of synthetic pipeline gas through Lurgi gasification of bituminous char. This investment figure does not include the pretreatment of plant, the cost of which is assumed to be reflected in the cost of the char fed to the gasification system. Shift conversion, CO_2 removal, and methanation are required after gasification in the Lurgi unit to make a gas suitable for pipeline transmission. Capital investment data are based upon equipment costs, January 1959. Based on a 330-day operating year, the operating cost/MCF at char price/ton of $4.00-$6.00 will vary from $0.56-$0.66.

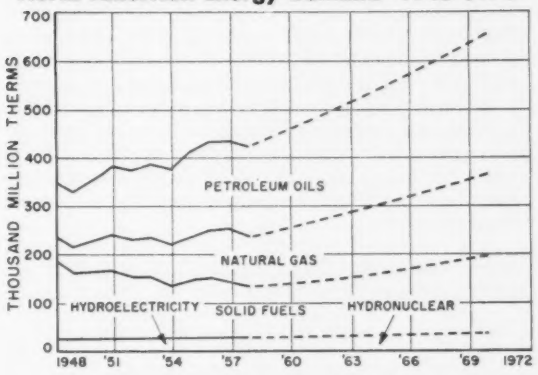
Appraising and Developing Managerial Personnel. H. C. Wyland. *Gas 36,* 47 (1960) Jan. (7 pp.)

Author outlines basic purposes of the management development program and its immediate objectives. The purpose of this guide is to provide a common basis for "taking stock" of present personnel resources and for development of talents and capacities to assure that both the present and future manpower needs of the company are met.

LILCO Developed—and Uses—Its Own Tailor-made Management Workshop. W. T. Harper. *Gas 36,* 54 (1960) Jan. (2 pp.)

Long Island Lighting Co. solved its problem of management training in depth by establishing a workshop tailored to its own needs and capable of training managers in groups of 20. At the same time it was appreciated that there could be no automatic process of developing managers. The best that could be done would be to give men with potential the tools with which they might help themselves.

North American Energy Demand—1948-1970



(Adapted from *Oil's Next Ten Years.* (See Abstract, p. 2)

Development and Evaluation of Gas-Condensate Reservoirs. Part 7. W. C. Goodson. *Petrol. Eng.* (Drilling and Producing) *32,* B-44 (1960) Jan. (5 pp.)

Fair market value has been defined by Paine in *Oil Property Valuation* as "the price at which the property would be sold by a willing seller to a willing buyer, neither being under any compulsion to buy or sell, and both being competent and having a reasonable knowledge of the facts." Author of article believes that while the definition is straightforward enough, the last phrase "having a reasonable knowledge of the facts" is the catch. What article attempts to do is to discuss some of the "facts" that should be analyzed by both parties—factors of tax, risk, percentage depletion, economic life, salvage, governmental regulation, discount values and other items that come with prolonged experience and judgment.

Management Science Solves Utility Problems. A. H. Schneyman. *Gas 36,* 56 (1960) Jan. (4 pp.)

Author presents case histories of the application of the scientific method to six different management problems in his company's system to illustrate the concept of blending the elements of management and the scientific method. Latter method consists of defining the problem, collecting and analyzing data, solving the problem, testing the solution, controlling the solution and management science.

Gas Industry Expansion

Industry Ends Fifties with Record Year and Confident on Trends in the Sixties. W. H. Ligon. *Gas Age 125,* 21 (1960) Jan. 7 (5 pp.)

Aggressive research and promotion have materially strengthened the competitive position of gas in the nation's energy markets. The 1959 result: Industry's annual sales exceeded the $5-billion mark; nation's 1350 distribution companies and 100 transmission companies now serve a record-breaking 32.6 million customers; construction outlays totaled a record $1.8-billion; gas sales increased 9% to cross the 80-billion therm mark; underground storage pools now number 205 with a 2.7-trillion CF ultimate capacity; nation's pipeline and main

network rose to 595,600 miles; industry's gross plant investment stands at $19.7-billion, up 8.8% over 1958; proved recoverable reserves in the U. S. reached the all-time figure of 254.1-trillion at the beginning of the year; automatic hot water heater sales set a new record in excess of 3 million units; ranges topped the 2-million mark; central heating equipment also set a new sales record, with a 24% gain for the year; the national programs for promotion, advertising and research ran to more than $7-million; research in 1959 covered nearly 70 projects.

27,419 Miles of Pipe Line Planned for 1960. M. A. Judah and D. G. DePugh. *Pipe Line Ind. 12,* 18 (1960) Jan. (2 pp.)

Survey of 245 companies reports a gain of 20% for Free World pipeline construction in 1960. Domestic natural gas pipelines laid in 1959 totaled 13,125; continued growth is reflected in the forecast of 14,525 miles scheduled for 1960. Foreign construction in 1960 will be increased with 9736 miles planned. Survey includes pipe diameters, station horsepower additions and prime movers to be installed.

Better Standards of Eating. W. T. Lane. *Gas Service and Domestic Coke 38,* 535 (1959) Nov. (8 pp.)

Catering load to the gas industry is a very important load. If it is assumed that probably the largest percentage of the commercial uses of gas are represented by the catering field it can be seen how large this business is. For the year ending March 31, 1959, 400 million therms were sold for commercial purposes (in England). This represents 15.4% of the total quantity of gas sold in the same period. Insofar as the number of consumers is concerned, this represents 615,000—nearly 5% of the total.

Competition

Oil's Next 10 Years. *Oil Gas J. 57,* 149 (1959) Dec. 28 (8 pp.)

Report, prepared by staff members of Shell International Petroleum Co., Ltd., indicates the following pattern of demand for the next decade. In North America the estimates show a fairly stable pattern between the primary energy sources (see graph). Petroleum fuels, which became the major contributor in 1952, will show the largest volumetric increase over the next ten years. In Western Europe petroleum by 1970 may be supplying 35% and solid fuels just over 40% of the total energy market. Compared with 1958, this represents a gain of some 12% of the market to petroleum fuels and a loss of over 20% by solid fuels. The share of hydroelectricity is unlikely to change significantly. The remainder of coal's loss will be taken up by natural gas and atomic energy, but these will remain small contributors during the period. In the rest of the world the changes in the pattern will follow the same course as in Europe but they will be less marked. Petroleum fuels may be approximately 50% of the total energy market by 1970, compared with 40% in 1958, while solid fuels may drop below 35%.

Oil-to-Gas Conversion Prospects. *Gas Heat and Comfort Cooling 10,* 36 (1959) Dec. (2 pp.)

Results of a nationwide market study of oil-to-gas conversion prospects indicate that, as of January 1, 1959, the automatic heating situation was: Total number of oil-fired central heating units in use, 9,324,935 or 46% of total oil and gas; total of gas-fired central heating units in use, 10,798,100 or 54% of total oil and gas; total oil- and gas-fired central heating units in use, 20,123,035; ten-year-old and older oil-fired central heating units in use, 2,145,420 or 11% of total oil and gas. Tabular breakdown is made on a state by state basis.

Fuel Oil in Industry. D. J. Heslop. *Fuel Efficiency 7,* 31 (1959) Dec. (4 pp.)

Oil fuel applications in British industry have steadily increased during the past decade. This increase has been most marked since 1954, particularly for steam raising, central heating and steel manufacturing purposes. Steam raising is the largest purpose for which oil is used, with the exception of public electricity generation where oil consumption has increased more than twelve-fold since 1948. It is likely that most of the fuel is consumed in shell boilers of the horizontal Lancashire and Economic types.

Appliances

Appliance Sales to Sizzle in '60. E. R. Martin. *A.G.A. Monthly 42,* 11 (1960) Jan. (2 pp.)

Analysis of questionnaires issued by the Gas Appliance Manufacturers Association shows that unit shipment increases for warm-air furnaces and boilers should top the 1959 records by 0.5 and 3.3%, respectively; (1,099,200 warm-air furnaces and 137,900 boilers were sold last year). A 2.9% rise is seen in combined sales of free standing and built-in gas ranges (1959 combined sales, 2,085,100 units). Sales of gas-fired water heaters for 1960 are expected to approximate 1959's all-time high (3,016,000). Increased sales also are predicted for direct heating equipment (individual room heater), incinerators, unit heaters (commercial type), duct furnaces and commercial gas ranges. Vented wall heaters and floor furnaces are expected to show a decrease in sales. (All figures in brackets are 1959 estimated sales.)

Pipeline Construction

Pipeline Push in Europe. *Chem. Eng. News 37,* 22 (1959) Dec. 28 (4 pp.)

Spurred by the discovery in 1951 of natural gas at Lacq, France, and by the development of oil in the Sahara, pipeline construction across Europe is booming. Two major systems, one in France and one in Germany, are currently in operation. By mid-1960 the Rotterdam-Cologne pipeline, 175 miles of 22.6-in. diam. pipe, will be in operation. Scheduled to get underway in 1961 is the 460-mile line stretching from Lavera in southern France to Strasbourg and later to Karlsruhe in Germany. The Italians are looking at two plans: One for a pipeline from Genoa to Agile, Switzerland;

the other to link Venice and Munich. In the Sahara desert the French have built a 410-mile pipeline from their Hassi-Messaoud oil fields to the Algerian port of Bougie. The biggest pipeline of all, 2500 miles, will be the Soviet line linking the USSR, Poland, East Germany, Hungary and Czechoslovakia.

New Ideas Highlighted Construction in 1959. M. A. Judah and D. M. Taylor. *Pipe Line Ind. 12,* 20 (1960) Jan. (7 pp.)

Costs of labor and equipment continue to rise, but the price per foot for pipeline construction has advanced very little. Contractors can keep up only by striving toward greater efficiency, better planning and a host of new ideas. Some of the top ideas of 1959 are discussed, including new ways to detect and analyze subsurface rock; use of a helicopter for pipeline construction; compacting soil at compressor station site; improved double jointing techniques; location of buried undersea pipelines; new undersea trenching machine; dewatering pipelines after hydrostatic tests with spheres; muffle furnaces to stress-relieve welds on heavy wall pipe; new coatings, and aluminum gathering lines.

Foreign Activities

Russia's Present and Future in Natural Gas. T. Shabad. *Gas Age 124,* 49 (1959) Dec. 10 (2 pp.)

Under its present seven-year plan, Russia hopes to increase the share of oil and gas in its energy picture by 50%. Whether it can accomplish this is still a big question. However, a close analysis of the country's energy programs, both past and present, gives a broad view of Russia's ability in the natural gas field. Contained in this article are comparisons of its production and consumption, the development of its fields and construction and operation of its transmission lines.

Offshore Operations

Offshore Outlook: Not Bad at All. H. Wilson. *Oil Gas J. 58,* 40 (1960) Jan. 11 (4 pp.)

Activity off the Louisiana coast will not set any records in 1960, but it will equal, or exceed, the high level reached during the last half of 1959. Development drilling will get the most attention, but new federal and state lease sales also herald some new exploration work. Crude oil production rose 14.28% in Louisiana in 1959 over the previous year, and a further rise for 1960 is predicted by the Louisiana-Arkansas division of the Mid-Continent Oil and Gas Association. Louisiana's daily production of crude and condensate during 1959 was 980,000 bbl. Predictions are that it will top the 1-million mark in 1960. Crude production totaled 318.3 million bbl during 1959, an increase of 39.6 million over 1958. Offshore production of 69 million bbl in 1959 accounted for 35% of Louisiana's total increase over 1958. Condensate production was up 12.88% for the year, rising by 4.9 million bbl to a total of 42.8 million. Gas production rose 13.62%, up 320 million MCF to a total of 2674 million MCF.

Coal

Wanted—A National Fuels Policy. W. Bradbury. *Coal Utilization 13,* 22 (1959) Dec. (10 pp.)

Experts say that the U.S. will be using 75% more energy in 1975 than it is using today. More coal, gas and oil will be needed, but the coal industry is dissatisfied with its interim role of standby fuel source while foreign residual oil and dump gas invade its traditional markets. Coal wants a national fuels policy to assure an energy fuels balance that will permit an orderly economic development of all three conventional fuels industries.

energy in 1975 than it is using today. More coal, gas

Research

Petroleum and Natural Gas Research Bureau of Mines, Fiscal Years 1954, 1955 and 1956. A. J. Kraemer. *U.S. Bur. Mines Inf. Circ. 7940.* (Washington: U.S. Dept. Interior, 1959, 79 pp.)

Report on research and experimentation by the Federal Bureau of Mines on technologic and scientific problems of the petroleum and natural gas industries presents a resume of work from July 1, 1953 to June 30, 1956. The preceding report, for the fiscal year ended June 30, 1953, indicated continuation of the Bureau's program of petroleum and natural gas research of worldwide significance, which began in 1910. The petroleum and natural gas research of the Bureau of Mines is divided into five main categories: 1) Production of petroleum and natural gas; 2) transportation and storage; 3) petroleum chemistry and refining; 4) thermodynamics and 5) economics. Report does not include work by the Bureau on oil-shale and shale-oil research and development.

Engineering Science and the National Science Foundation. G. B. Carson, C. C. Chambers, G. M. Nordby, R. A. Morgen and R. H. Roy. *J. Eng. Education 50,* 199 (1959) Dec. (8 pp.)

Five-part report was undertaken because of the opinion which persists throughout engineering schools and colleges that the National Science Foundation (NSF) has been prejudiced against engineering in awarding funds for research grants, fellowships, and summer institutes and conferences. First part of the report discusses organization and purposes of the NSF and their relevance to the engineering sciences; part 2 deals with research grants and part 3 with research proposals, how they should be prepared and how they are evaluated and awarded or rejected. Fellowships constitute the fourth section, and the final portion deals with NSF support for summer institutes and conferences. The objective is to present constructive suggestions and direction to the Society, rather than merely to voice criticism of the Foundation.

Support of Basic Research by the Engineering Sciences Program of the National Science Foundation. A. H. Waynick, K. G. Picha, F. M. Kobayashi and J. N. Reeds. *J. Eng. Education 50,* 207 (1959) Dec. (9 pp.)

Report presents in some detail results of a study of the National Science Foundation's (NSF) activities in the support of basic research in the engineering sciences over the past several years. Report discusses the manner

in which the program is administered, and gives several interesting results concerning the basic research grants made to the nation's engineering schools.

Air Conditioning

Battelle Grants Piston License to Robertshaw. W. T. Harper, *Gas 36,* 60 (1960) Jan. (2 pp.); **Robertshaw-Fulton to Enter Conditioning Field with Free Piston Compressor System.** *Gas Age 125,* 18 (1960) Jan. 7 (2 pp.); **Free Piston to Boost Gas Air Conditioning.** *A.G.A. Monthly 42,* 17 (1960) Jan. (2 pp.)

Advancement of the natural gas industry into the residential air conditioning field took what many believe to be its biggest step early in December when it was announced that the Robertshaw-Fulton Control Co. had been granted exclusive license to manufacture and market the Free Piston Refrigerant Compressor. This compressor was developed by Battelle Memorial Institute in Columbus, Ohio. Work on this project started over four years ago, about the time that the American Gas Association put the following question to the people at the Institute: "How can the potential energy in natural gas be transformed into a refrigerating effect with high efficiency and low first equipment cost in such a way as to be attractive for residential air conditioning service?" (See also article on p. 15 of this issue.)

Air Pollution

A Digest of State Air Pollution Laws. S. M. Rogers and S. Edelman. U.S. Public Health Service Publication No. 711. (Washington, U.S. Supt. Documents, U.S. Government Printing Office, 1959.)

Digest of state laws relating to air pollution was prepared with the assistance of the Public Health Division, Office of the General Counsel, Department of Health, Education, and Welfare, from an examination of pertinent state statutes. It is anticipated that the Digest will be revised and supplemented from time to time to enhance its usefulness and to keep it current with new legislation. It is hoped that the Digest will be of assistance in the consideration and evaluation of State air pollution control legislation, both existing and proposed.

Equipment

1960 Directory. Heating, Piping, and Air Conditioning Equipment for Industrial, Commercial, Institutional and Public Buildings. *Heating, Piping & Air Conditioning 32,* ld (1960) Jan. (178 pp.)

Four-part directory contains products advertised in current issue classified in directory style; alphabetical product classification, along with names of manufacturers; product trade names alphabetized, identified with names of manufacturers, and names and addresses of all manufacturers.

1960 Gas Engineering and Appliance Directory. *Gas Age 124,* 31 (1959) Dec. 24 (56 pp.)

Directory contains classified list of every important product used in the gas industry and claims to be the only comprehensive listing of all sources of supply now available.

Natural Gas Production

Natural Gas Production Passes 13 Trillion Cubic Foot Mark. *Gas Age 125,* 38 (1960) Jan. 7.

Preliminary estimates released by the A.G.A. and the Bureau of Mines indicates that the gross production of natural gas in 1959 is 13.6 trillion CF, up 611 billion from 1958. Production of natural gas liquids also reach a new high in 1959, the estimated figure being 319,350,000,000 bbl. Completions of wells, including exploratories, also turned up from the previous year, but were still far below the records achieved in 1956. Gas well completions in 1959 totaled 3750, a small gain over the 1958 figure of 3679. Exploratory gas well completions last year were 275, compared with 273 in 1958.

Automation

Control Enters a New Decade. W. E. Vannah. *Control Eng. 7,* 101 (1960) Jan. (7 pp.)

Economists have peered into the coming decade and have foreseen the "Golden Sixties". Labor unions have laid out a schedule of objectives that may lead to a four-day work week sometime in the sixties. Business editors predict that "plants with unbelievable automaticity" will be built to produce the economic bonanza and to make possible a shorter work week. Both will hinge on automatic systems of a more and sophisticated character. Three key influences will determine the basic nature and scope of the control engineer's work: Growth in the national product, increase in the use of control products to effect the production growth, and the development of new control techniques.

Petrochemicals

The Production of Petroleum Chemicals in Holland. J. L. Edgar. *Chem. & Ind.,* 1586 (1959) Dec. 19 (7 pp.)

In Holland there are only two plants where chemicals are produced from petroleum. By far, the more important is the Pernis chemical plant of the Royal Dutch/Shell Group. With its annual intake of about 15 million tons of crude oil it is the largest oil refinery in Europe. Traditionally Holland has been a large producer of fertilizers and an exporter of fixed nitrogen. In 1956, one of the three major fertilizer plants, the Mekog (Maatschappij tot Exploitatie van Kooksvengassen N.V.) changed over from coke to the partial use of petroleum as feedstock. Chemicals are produced at Pernis from hydrogen sulfide, ethylene and from propylene. In addition, higher olefines are produced, and from these a range of detergents and other chemicals is manufactured; acetylene is produced specifically for the production of insecticides. From hydrogen sulfide, sulfur of extremely high purity is produced.

Maintenance

Chemical Cleaning of Equipment in Refineries and Petrochemical Plants. L. N. Klinge and J. Selman. *Corrosion 16,* 9t (1960) Jan. (10 pp.)

Advantages of chemical cleaning in refineries and petrochemical plants over mechanical methods are discussed. The necessary steps are analyzed for deposits to be removed, chemical agents used in cleaning, effects of these agents on construction materials and cleaning of equipment *in situ*. Article includes discussion of cleaning of columns, coolers, condensers, heat exchangers, boilers and drums. Potential corrosion difficulties encountered in chemical cleaning are described. Auxiliary equipment needed also is discussed. A bibliography of 258 items on chemical cleaning and related subjects is included.

2. ENERGY SUPPLY AND ECONOMICS

Natural Gas Reserves

The Role of Gas in Meeting Future Energy Demands. M. A. Elliott. *Proc. Pacific Coast Gas Assoc. 50,* 26 (1959) (7 pp.)

In order to gain perspective in considering the future role of gas as a source of energy it is necessary to examine the magnitude of the total energy demand likely to be supplied by gas and the probable availability of natural gas and of other fossil fuels for producing supplemental gas. An over-all analysis of the relation between probable future rate of production and projected demand indicates that supplemental gas may be required sometime in the period 1975-85. It is now known that imported liquefied natural gas can be used as a source of supplemental gas. For longer-range sources, gasification of solid fossil fuels—coal and oil shale—will be necessary. Such gasification processes are under development as a part of the gas industry's long range research program. Article reviews pertinent studies on the over-all energy problem with particular emphasis on the role of gaseous fuels in helping to meet future energy demands for the U. S. Review covers the period from the present to the year 2000.

Natural Gas Production

Natural Gas Supply and Price Trend. *Gas Age 125,* 29 (1960) Jan. 7 (5 pp.)

Latest Federal Power Commission figures indicate that during 1958 slightly less than 5600 producers of natural gas supplied 6,857,029,776 MCF of natural gas to interstate natural gas pipeline companies for revenues of $890,683,488. The average cost to the pipeline companies was $.13/MCF. Of these producers, 48, alone or as the first-named in combination with others, supplied approximately 73% of the natural gas purchased. A total of 250 of the producers reported sales of 2 MMCF or more; these sales accounted for 91.2% of both the total natural gas supplied and total revenues received. Article includes a complete listing of natural gas producers, their total sales and price per MCF.

Petroleum Reserves

Pakistan's First Oil Find: Karsal No. 3 a Producer. *Progress 4,* 1 (1959) Nov. (2 pp.)

Proving of the first oilfield since the inception of Pakistan (1947) was announced on October 21 when, following successful production tests, Karsal well No. 3 was declared a commercial oil producer. These tests showed a producing potential for this well of about 800-1000 bbl/day of oil, and when it is put on regular commercial production in the near future, Pakistan's indigenous production of crude oil is expected to be enhanced by approximately 20%.

The Development of Chinese Petroleum Resources. F. Slezak. *Erdol u. Kohle 12,* 910 (1959) Nov. (6 pp. German text.)

Available literature regarding oil development in China is reviewed from the basis of older European and recent Chinese geological reports. Reserves of 5.9 billion tons are reported for 1958, with 12,000 geologists in over 500 exploration groups, and 1959 total production estimated at 4,670,000 tons. Each region is discussed in detail with many references.

LPG

A Billion Gallons in a Single Month. G. R. Benz, W. F. DeVoe and P. W. Tucker. *Butane-Propane News 22,* 58 (1960) Jan. (3 pp.); **LP-Gas Sales Climb as Industry Records 1st Billion Gallon Month.** *Gas Ind. 4,* 1 (1960) Jan.; **LPG Sales Climb to New All-Time High.** *Oil Gas J. 57,* 45 (1959) Dec. 21; **LP-Gas Boom Continues.** *Gas Age 125,* 34 (1960) Jan. 7 (5 pp.); **'59 LP-Gas Sales Rise 16.5 Per Cent.** *A.G.A. Monthly 42,* 9 (1960) Jan. (4 pp.)

Excerpts from the latest "Phillips Report" indicate that the LPG industry, which 15 years ago first enjoyed annual sales in excess of 1 billion gal, set a new record in December 1959—sales of over 1 billion gal in a month. It was a tremendous sales year, according to early estimates. The total gallonage equalled 8,693,000,000 gal, up 16.5% over 1958, which was 7.5% ahead of 1957. Of this total, 3604 million gal went to domestic and commercial use, 937 million gal to motor fuel, 1020 million gal to industrial and miscellaneous use, 245 million gal for gas manufacturing, 2396 million gal for chemical manufacturing and 491 million gal for rubber components.

Methane Liquefaction

Liquefaction: New Gas Market. J. de Lury. *Chem. Eng. 66,* (1959) Dec. 14 (4 pp.)

Market potentialities of liquefied methane and its transportation and storage are reviewed. The choice of refrigeration cycle, whether cascade or expansion, and factors determining the choice and design, especially composition and properties, are discussed briefly with the aid of recent references.

Space Heating

Better Standards of Heating. W. F. Moore. *Gas Service and Domestic Coke 38,* 532 (1959) Nov. (3 pp.)

Perfect heating system is like to come only when all buildings are designed from the sketch plan stage with the heating system and fuel already decided in principle.

In the meantime, compromises must be made, says author. Controllability is a desirable feature of any system and, although available in one way or another with all modern heating appliances and methods, gas systems dominate them all in this respect. Trends of costs in terms of 'therms of heat in the fuel' is still broadly in the rising order—solid fuel, oil, kerosine, gas and electricity. But the real values of fuels have tended to approach more and more closely to one another in recent years. With better standards of structural insulation now becoming more customary, the differences will become still less.

Peak Shaving

CCR Set Meets Peak-Shaving Needs. C. B. Glover. *A.G.A. Monthly 41,* 25 (1959) Dec. (2 pp.)

Continuous Catalytic Reforming (CCR) process produces an oil-gas with a calorific value of 800 Btu/CF. Statistics for two year-period indicate that in both years the catalytic process showed substantially better yields of oil-to-gas when compared to the thermal process. During the latter part of the second winter, cracking conditions were changed to produce a CCR oil-gas of approximately 950 Btu/CF.

Coke Ovens

The Rourkela Steel Works of Hindustan Steel Ltd. Within the Framework of India's Industrialization. W. Fitz. *Gas- u.-Wasserfach 100,* 1217 (1959) Nov. 20 (9 pp. German text.)

With an introductory review of India's economy and planning, a brief discussion is given of the Rourkela steel works, one of the three new mills now under construction. This plant, with three 100 ton/day blast furnaces, is described with special emphasis on the coke oven facility, with layouts, flowsheets and photographs. Details are mentioned of tar, benzol, ammonia and sulfur recovery and refining equipment. Essential purification units went into operation December 2, 1958, with the first of three batteries of 210 Otto underjet ovens.

Exploration

Giant Argentine Program Launched. R. J. Enright. *Oil Gas J. 58,* 61 (1960) Jan. 4 (3 pp.)

Rigs started making hole in Argentina's Comodore Rivadavia region the first week in January to launch operations under perhaps the largest single drilling contract ever negotiated. Activities marked to actually start this tremendous project—drilling of 1000 development wells by Southeastern Drilling Co. of Argentina, an affiliate of Southeastern Drilling Corp., Dallas.

Major Discoveries Spur Huge Play in Canadian North. *World Oil 149,* 103 (1959) Dec. (4 pp.)

Most northerly reaches of Canada, including the vast Arctic Island Archipelago, currently are receiving exploration attention reminiscent of the 1947 Leduc discovery which touched off one of the greatest oil and gas exploratory campaigns ever waged. Millions of acres in the far north country now are being explored by ground parties, numbering about 70 at the peak of activity in July 1959. Seven drilling rigs are expected to start probing the subsurface of Canada's far north early in 1960. At present, applications totaling more than 95 million acres in the Arctic Islands by more than 25 individuals and companies are pending.

Offshore Operations

Sea of Japan Site of First Offshore Oil Strike in the Far East. J. A. Kornfeld. *Petrol. Eng.* (Drilling and Producing) *32,* B-31 (1960) Jan. (3 pp.)

World's newest offshore oil province came into production in November 1959, with the official announcement of the completion of a flowing oil well drilled from a platform situated 1.4 miles off Akita City on the northwestern shores of Honshu Island, the mainland of Japan. Although the Japanese domestic oil industry is more than 60 years old, current crude production rates, averaging 7021 bbl/day, amount to only 2.53% of the 1958 refinery runs of 277,400 bbl/day.

Solar Heating

What Future for Solar Heating? R. C. Jordan. *ASHRAE J. 2,* 74 (1960) Jan. (4 pp.)

Within most of the U.S., solar space heating is feasible technically but economically marginal. Though it may seem that the use of solar energy for space heating should be both cheap and simple, since the quantities of energy available are vast and widespread, this energy, so free for the taking, is expensive to collect and to store. The total solar energy striking the land area of the U.S. is of the order of 313,000 kw hr per person per day, and the amount striking the roof of an ordinary house in the southern part of the country averages roughly 2 million Btu/day. It is so diffusely spread that large collection areas must be involved, and it is so variably available that for space heating it must be stored and supplied upon demand.

Fuel Cells

Shaped Porous Semi-Conducting Compositions of Lithiated Nickel Oxide. E. Gorin and H. L. Recht (assigned to Consolidation Coal Co.) U.S. 2,914,596 (1959) Nov. 24.

Process is claimed for producing a porous lithiated nickel oxide body for use as the air electrode in a high-temperature gas fuel cell. Soluble lithium salts are slurried with powdered nickel oxide, dried, calcines at 1000-1300°C crushed, compressed with a wax binder, recalcined, crushed, and the fraction through 48 mesh on 65 mesh is remolded with the wax binder at 5-10,000 psi to electrode form, which then is calcined 12 hours at 1400-1600°C. Such electrodes are successfully used as gas or air electrodes with a molten lithium-sodium carbonate electrolyte without corrosion.

Tar Sands

Oil and Gas Recovery from Tar Sands. G. J. W. Salomonsson (assigned one-half to Svenska Skifferolje AK and one-half to Husky Oil Co.) U.S. 2,914,309 (1959) Nov. 24.

Hydrocarbons are recovered from tar sands by a pyrolysis *in situ* process by heating, in the drill hole, the sand formation in a zone progressing vertically, or both vertically and horizontally, causing cracking and coking to form a zone permeable to vapors. The vapors carrying oil condensates may escape through a concentric well pipe, or may be driven laterally to adjacent outlet wells in coked-out areas.

3. NATURAL GAS AND PETROLEUM PRODUCTION

Core Testing

Portable Core Analysis Lab Saves Offshore Rig Time. R. E. Lampkin. *World Oil 150,* 145 (1960) Jan. (3 pp.)

Specially designed portable laboratory, equipped for complete core analysis tests, was constructed and used initially on a Standard Oil Co. of California-Humble Oil & Refining Co. well, on the Standard-Humble State lease being drilled from a platform about 2 miles offshore near Santa Barbara, Calif. From this and subsequent tests using the portable equipment, substantial savings in coring costs could be made in cases where 1) it is desirable to have permeability and saturation data to prevent excessive penetration into a wet or transitional zone; 2) the company geologist or engineer can be relieved of the burdensome and time-consuming job of meeting each core; and 3) rig time can be reduced when immediately available core analysis results will help in deciding whether or not electrical logging, fracing, formation testing or other services should be ordered out to the well.

Drilling

New Drilling Technique Recovers 100 Percent Continuous Core. H. Henderson and J. F. Earl. *World Oil 150,* 111 (1960) Jan. (8 pp.)

While seismograph and other geophysical and geological exploratory techniques have been used extensively and successfully in finding oil reserves, these methods are limited to structural trap indications and not used primarily to locate hydrocarbon accumulations in stratigraphic traps. Drilling is the only known method to satisfactorily find and develop these traps. And drilling is costly and not too satisfactory. However, a continuous coring method recently has been introduced. Operation of this technique was conducted in an old developed oil province near Abilene, Texas. This test was successful in recovering 100% cores for the depth drilled, and it pointed to the practicability of this technique for use in exploratory and development drilling.

Revolutionary Rig May Solve Some Old Drilling Problems. *Oil Gas J. 58,* 48 (1960) Jan. 4 (2 pp.)

Description of new rig which is undergoing first field trials. Features include: Reverse circulation to reduce the volume of mud needed to keep the hole clean; concentric drill string to keep pump pressure off the formation; exclusive utilization of core bits, mostly the diamond type; use of a power swivel to rotate system so that the bit does not have to be lifted from the bottom to make connections; continuous circulation of cores to the surface.

What's Needed for a 50,000-ft. Hole? *Petrol. Week 9,* 30 (1959) Dec. 18 (3 pp.)

Drilling, equipping and producing of a 50,000-ft hole has become a favorite topic of oil's engineering and research groups. Three specialists looked at the problems involved and concluded, in brief, that modification of existing drilling equipment and tubular goods could make possible the drilling and equipping of such a well, but producing it would be as rough a mechanical challenge as the industry has ever faced.

Drilling Muds

Conditioning Mud for Well Completion. Part 3. R. W. Ruhe, Jr. *Petrol. Eng.* (Drilling and Producing) *32,* B-22 (1960) Jan. (4 pp.)

Mud and logging programs should be closely coordinated. Some formations can be damaged by drilling mud or drilling mud filtrate, and certain muds have been found to offer protection to sensitive producing zones. Today, completion muds should be selected on the basis of several considerations. Regardless of whether the drilling mud is used or a special completion mud prepared, the same consideration should be applied.

Exploration

Prospects Vary Widely in Northern South America. C. A. Moore. *World Oil 149,* 130 (1959) Dec. (4 pp.)

While production in Ecuador has been limited to the Santa Elen Peninsula and limited exploration elsewhere has failed to locate a second oil province, several basins in Colombia have been proved oil-bearing and vast new areas remain to be tested. In Venezuela, major reserves continue to be found in both western and eastern basins; and possibilities remain in the Barinas-Apure Basin, the most recent to be opened to commercial production. Article is illustrated with generalized sedimentary sections for each area of interest.

South Dakota Oil Prospects Becoming Better Known. A. F. Agnew. *World Oil 149,* 112 (1959) Dec. (4 pp.)

Many areas and stratigraphic units remain untested in South Dakota, although at least 350 oil tests had been completed in the state by mid-1959. Facies and permeability traps, unconformities, folds and hydrodynamic conditions have helped localize hydrocarbons in South Dakota. Mesozoic and Paleozoic beds have indicated many oil and gas shows, notably in the Williston Basin, where significant pumper oil production has been established at Buffalo Field in Harding County; and in areas surrounding the Black Hills. The Kennedy and Forest City basins extend into the state from Nebraska. Oil shows have even been found in Precambrian strata in South Dakota.

Offshore Operations

Drilling Record Set at Offshore Well. *Oil Gas J. 58,* 44 (1960) Jan. 11.

Gulf Oil Corp. has established a challenge for fast drilling that other organizations may be trying to better for some time. The company drilled to 10,000 ft in an offshore well only 4 days and 22 hours after the hole was spudded. Kermac's Rig 46 was used for the job. The task was achieved on Gulf's well No. 14 in its State Lease 1423 Block 21, Timbalier Bay area, off the coast of southern Louisiana.

Reservoir Engineering

A Demonstration of the Effect of "Dead-End" Volume on Pressure Transients in Porous Media. I. Fatt. *J. Petrol. Tech. 11,* (Tech. Note 2048) 66 (1959) Dec. (5 pp.)

Study of a model which contains "dead-end" pore volume indicates that pressure transients are influenced by the amount of dead-end pore volume and by the resistance of the flow path between the dead-end pore volume and the main flow channels. A semi-empirical method is demonstrated that makes possible measurement of the volume in the dead-end pores and the total pore volume. The difference between these two volumes is the volume of the flow channels. An indication of the flow resistance between the dead-end pore space and the main flow channels also is obtained.

Effect of Viscosity Ratio on Relative Permeability. A. S. Odeh. *J. Petrol. Tech. 11,* (Tech. Paper 8098) 346 (1959) Dec. (7 pp.)

Mechanism of two-phase flow in porous media has been a subject of wide controversy. One of the properties essential for understanding the dynamic behavior of two-phase flow is relative permeability. Relative permeability to a certain phase is defined as the ratio of the effective permeability of that phase to its permeability when it is the only fluid present and flowing. In this research, a theoretical analysis was made to determine the effect of viscosity ratio between the nonwetting and the wetting phase on relative permeability. Experimental work was conducted to test the validity of the derived equations.

Pressure Maintenance and Model Studies. W. W. Eckles, Jr. *J. Petrol. Tech. 11,* 17 (1959) Dec. (5 pp.)

Pressure maintenance programs play an important role in the efficient and economical recovery of oil and gas. For this reason, it is advantageous to consider carefully all of the factors involved in the design of an efficient pressure maintenance program. The purpose of the article is to 1) review the methods of evaluating past reservoir performance and predicting future performance for various proposed plans of pressure maintenance operations, and 2) discuss the use of potentiometric model studies in designing pressure maintenance programs.

Well Practice

Concentric Completions of Oil and Gas Wells. G. M. Harper, Jr. *J. Petrol. Tech. 11,* 22 (1959) Dec. (3 pp.)

Article discusses the use of 1¼-in. tubing placed concentrically inside the normal flow string in both oil and gas wells. The use of this extra string provides an annular space which can be employed to perform a number of functions. The Union Oil Co. of California is probably one of the few companies still completing dual oil and gas wells concentrically, where feasible, rather than using parallel strings of tubing. In view of the economics, further consideration should be given to concentrically completing dual oil wells before deciding to incur the extra expense of larger hole, larger casing sizes and two strings of tubing required for parallel duals. Particularly this is true where past history of the two zones is available.

Continuous Flow Gas Lift Design. K. E. Brown and C. R. Canalizo. *Petrol. Eng.* (Drilling and Producing) *32,* B-26 (1960) Jan. (5 pp.)

It is generally conceded that the most important factor in continuous flow design is the determination of the correct point of gas injection. Past well performance has shown that the lower the gas injection point, the lower the injection gas-oil ratio. The principal governing factors in design are 1) the available injection gas pressure and volume, 2) the wellhead tubing back pressure, 3) the flowing bottom hole pressure, 4) the well fluids, which include oil, gas and water, and 5) the size and depth of the eductor tube. Two methods are presented whereby the point of gas injection can be determined. Both methods use the maximum surface injection gas pressure. The first is a simplified procedure which can be used to determine the point of gas injection quickly by use of a graph. The second, a more detailed method, also is explained and a modified version of this method by the use of "Standing's Composite Volume Factor Chart" is presented.

Here's How to Improve Your Gas Lift Installations. Part 5. Estimating Injection Gas Volumes Used by Intermittent Wells. H. W. Winkler. *World Oil 149,* 107 (1959) Dec. (5 pp.)

Easy-to-use method has been developed which permits operators to estimate injection gas volumes used by intermittent wells with reasonable accuracy. The method is based on the volume of injection gas required to obtain a given pressure buildup in the casing during an injection gas cycle. The volume of injection gas per cycle can be estimated by calculating the volume of injection gas in the casing annulus immediately before the time cycle surface controller opens and the volume of gas in the casing at the instant the surface controller closes. The difference is assumed to be equal to the injection gas that passes through the operating gas lift valve during each cycle.

Here's How to Improve Your Gas Lift Installations. Part 6. The Use of Gas Lift Valve Specifications and Force Balance Equations. H. W. Winkler. *World Oil 150,* 129 (1960) Jan. (7 pp.)

Valve specifications and force balance equations play an important role in solving the numerous problems encountered in engineering gas lift installations. Article includes five important calculations utilizing this type

information: 1) Determination of operating valve from surface closing pressure; 2) calculation of approximate per cent fall-back using surface casing pressure; 3) design based on surface closing pressure of valves; 4) determination of opening pressures of unloading valves in a continuous flow installation, and 5) determination of reopening pressure of valve or valves above operation valve in a continuous flow installation.

How to Cut Sour Gas Well Completion Costs. K. N. Wallam and V. P. Milo. *World Oil 149,* 83 (1959) Dec. (6 pp.)

Using calculated hydrate curves and down-the-hole temperature surveys, Shell Oil Co. of Canada has been able to predict the subsurface hydrate problem in sour gas wells. These surveys also permit determination of the efficiency of a particular hydrate-control system. In many cases well completion costs have been reduced as much as $16,000 because it was discovered that hydrate-control equipment was not required. A possible additional saving of $30,000 can be made by reducing casing size from 7- to 5½-in. when no 5-in. circulating string is required.

How New Additives Improve Deep Well Cementing. Part 2. J. O. Woodson and C. L. Fulton. *World Oil 149,* 144 (1959) Dec. (12 pp.)

Drilling of Phillips Petroleum Company's three deep tests, University EE-1, Harral A-1 and Montgomery A-1, were all conducted simultaneously. The cementing operations, primary and secondary, also took place at the same time. Consequently, in view of the numerous cementing operations, only the most interesting ones are discussed. Many of the cementing jobs performed on these wells required the checking and rechecking of thickening times of the recommended slurry to insure its successful placement behind the pipes.

4. GAS CONDITIONING AND LPG RECOVERY

Dehydration

The Calcium Chloride Gas Dehydrator. R. H. Ackermann. *World Oil 150,* 105 (1960) Jan. (7 pp.)

Calcium chloride gas dehydrator has been found to operate efficiently over a wide range of gas flow rates, pressures and temperatures. Many units are in service operating at temperatures ranging from 50-120° F, and at pressures ranging from 100-2000 psig. These units are designed to have a maximum 8 psi pressure drop at gas flow rates from 1-20 MMSCF/day. The unit has no moving parts, requires no regenerative heater or process pump and will operate efficiently and unattended for long periods of time. It is practicularly suited to remote locations which are inaccessible for long periods because of adverse weather conditions.

The Long Cycle Dry Desiccant Dehydrator. J. R. Heumann and J. Loomer. *World Oil 150,* 100 (1960) Jan. (5 pp.)

Long cycle dry desiccant dehydration unit is widely used as a means of drying natural gas in the field. Many producers have installed or are installing compressor and dehydration field facilities on the lease to collect, dry and sell gas. Because of this trend and the ability of the dry desiccant unit to provide low dew points, the method has become one of increasing interest to production personnel. New desiccants, improved equipment and automation have further stimulated interest and increased acceptance of the technique. Article discusses equipment, regeneration, advantages and disadvantages, operating problems and applications.

Hydrogen Sulfide Removal

Gas Purification Plant for Ammonia Synthesis. W. Guntermann. *Gas- u.-Wasserfach 100,* 1225 (1959) Nov. 20 (5 pp. German text.)

Modern system of purification is described for cleaning gas from a Koppers-Totzek oxygen gasifier using crude oil. Removal of impurities comprises the following sequence: COS conversion to H_2S by alumina catalyst, removal of H_2S and CO_2 by the alkazid process, conversion of CO to CO_2 and H_2, trace removal of H_2S by oxide tray towers and of final CO by the Grammarco process.

How Much Sulfur from Natural Gas? C. R. Graham. *Can. Chem. Processing 43,* 59 (1959) Dec. (7 pp.)

New Canadian sulfur producers must compete not only with those from the big sulfur domes of the U.S. Gulf Coast and Mexico, but also—in all cases where sulfuric acid is an intermediate—with domestic firms of great size who are peddling a competitive product. Moreover, the sulfur values from smelter fumes are even more of a waste product than the hydrogen sulfide from natural gas. Although western producers will be able to produce more than 2 million tons/yr of sulfur, they are not likely to be able to sell all of it before 1965 or even later.

With Lacq, France Gets into the Export Business. A. E. Chute. *Oil Gas J. 57,* 138 (1959) Dec. 28 (6 pp.)

When planned expansions to the gas-processing plant at Lacq are completed, daily production rates will be: 500 MMCF/day of dry, purified pipeline natural gas; nearly 4000 tons of sulfur; 240,000 gal of highly aromatic high-octane gasoline, and 300,000 gal of LPG. This will permit a reduction of about 10% in the country's imports of fuels, and will convert France from a sulfur-importing to a sulfur-exporting nation.

Organic Sulfur

Organic Sulfur in City Gas—A Literature Review. W. Janicke. *Gas- u.-Wasserfach 100,* 1281 (1959) Dec. 4 (4 pp. German text.)

Use of coals rich in sulfur for gas production in many countries and the increasing demand for purity of the gases brings the processes of organic sulfur removal into a position of importance. The disagreeable action of the organic sulfur at the place of use through its combustion products and its tendency to form resinous bodies in valves and regulators is discussed. The origin of these impurities and their distribution in kind and proportion

in products of carbonization are given. References are cited regarding methods of determination of these sulfur compounds in gas. Present known processes for removal and their advantages and disadvantages are discussed in classifications as to chemical and physical basis of operation.

Separators

The Low Temperature Separation Unit. G. J. Mapes. *World Oil 150,* 93 (1960) Jan. (8 pp.)

Low temperature separation (LTS) unit consists of five basic components: 1) the low temperature separator; 2) the free liquid knockout; 3) the heat exchanger; 4) the choke, and 5) the flash or second stage separator (optional). Adequate piping, valving, etc., are required to complete the unit. In addition, line heaters often are used upstream of the LTS unit to heat the input gas stream. Article discusses each of the component parts of the LTS unit, the various types of low temperature separators, use of LTS units with accessory equipment (stabilizers, steam generators, glycol injection systems), piping and hook-ups, and some operating techniques.

The Oil and Gas Separator. C. K. Gravis. *World Oil 150,* 84 (1960) Jan. (9 pp.)

Oil and gas separators are one of the most basic items of producing equipment used in the field today. Although separators are widely used in the oil country they still must be selected with care for particular applications. Proper consideration of liquid and gas capacities for the different type units and careful application of correct operating procedures will result in trouble free, unattended operation for long periods. The separator is constructed in the following basic shapes: vertical cylindrical, horizontal cylindrical (single or double barrel), and spherical. These shapes are discussed in terms of design, advantages and disadvantages, gas capacity and liquid capacity.

5. NATURAL GAS TRANSMISSION

Compressor Stations

An Electrical Power System for Unattended Remote Controlled Gas Compressor Stations. R. W. Smith, Jr. *Pipe Line News 31,* 31 (1959) Dec. (4 pp.)

System described is designed to provide electrical operating power under most any adverse condition. It consists of four sections: 1) Power distribution center; 2) No. 1 compressor building lighting and distribution center; 3) No. 1 compressor building motor control center, and 4) the emergency a.-c. and d.-c. power system.

Pushbutton Compression. J. Joseph. *Gas 36,* 93 (1960) Jan. (8 pp.)

Description of new $2.5 million station of the City of Long Beach (Calif.) gas department's compressor Station No. 6. The 1.5 MMCF/hr capacity of this station ups the city's system total some 25% and is as unique flowwise as it is uniquely automated: The plant both in design and concept is built around a 10-ft diam suction sphere which replaces—and largely substitutes for —normally long and costly suction headers.

Fluid Flow

A Mathematical Study of Two-Phase Flow in Well-Flowlines. Part 2. B. T. Yocum. *Petrol. Eng.* (Drilling and Producing) *32,* B-59 (1960) Jan. (5 pp.)

Article completes a discussion of simultaneous flow of gas and oil in wells and flowlines and solves example problems with equations developed in Part 1 (see *Gas Abstracts 15,* 364).

A New Flow Equation for Gas Transmission Pipelines. E. Gordon. *Pipe Line News 31,* 20 (1959) Dec. (3 pp.)

For his derivation, author started with the supercompressibility factor correlation recommended by the American Gas Association in Orifice Meter Report No. 3. New flow equation derived by author using these friction factor and compressibility equations can be written

$$\frac{Q_o P_o}{38.73\, T_o D^{2.5} \sqrt{1/f}} = \sqrt{\frac{F_1(p_1) - F_1(p_2)}{L} + .0375 \left[\frac{H_1 - H_2}{L} + \frac{U_1^2 - U_2^2}{2gL} - \frac{5280}{g}\frac{\partial U}{\partial \Theta}\right]\left(C_1 F_2(p_1) + C_2 F_2(p_2)\right)}$$

where g = gravity, 32.2 ft/sec^2; H_1 = elevation, upstream end pipe, ft; H_2 = elevation, downstream end pipe, ft; L = length of pipe, miles; P_0 = base pressure, 14.9 psia; p_1 = pipeline pressure, upstream end, psia; p_2 = pipeline pressure, downstream end, psia; Q_o = gas flow, SCF/day; T_0 = base temperature, 520° R; U_1 = gas velocity, upstream end, ft/sec; U_2 = gas velocity, downstream end, ft/sec; $\frac{\partial U}{\partial \Theta}$ = rate change velocity, ft/sec^2. The functions of pressures F_1 (p) and F_2 (p) are evaluated by computer from the supercompressibility ratio Z_o/Z from AGA Orifice Meter Report No. 3.

Pipeline Construction

Designing Pipe Line Crossings of Railroads and Highways. E. A. Slade. *Pipe Line Ind. 12,* 31 (1960) Jan. (6 pp.)

Several methods can be used in designing pipeline crossings of railroads and highways. These include: The API Code 1102, the American Railway Engineering Association, and the Design Criteria advanced by the American Society of Civil Engineers. Problem of design, in reality, is comparatively simple—it is a matter of soil mechanics and strength of materials. However, the attitude of the governing bodies must be correlated to the engineering problems involved.

Heavy Equipment Whips Stubborn California Terrain. R. E. White. *Pipeline Eng. 32,* D-25 (1960) Jan. (2 pp.)

About 75 tractors were used on the right-of-way clearing and grading operation on the Cuyama Valley-Ventura, Calif., 58-mile pipeline construction job.

Excavating trench through this country was as tough a problem as right-of-way grading, with a major portion requiring blasting to move the rock. A total of six wheel-type trenchers were used to excavate trench where the ground was suitable or to expose sections of rock and define areas to be drilled and shot. Ditch line was also ripped, using tractor-mounted hydraulic rippers where possible.

New Type Aerial Bridges on Houston Texas System. W. F. Appelt and M. Fitzpatrick. *Pipe Line Ind. 11,* 27 (1959) Dec. (5 pp.)

Five new overhead crossings on the Houston Texas Gas and Oil Corp. line feature a number of advanced ideas. Box girder section tilt-up erection towers provide for quick economical construction with more than adequate strength. Main cable design is calculated on a modified parabolic basis assuming a uniform load on a horizontal line. Before erection, the completed pipe string and assembled suspension cable system was floated across the river. From the design principles in these bridges, the authors investigate some of the future possibilities for low cost, overwater pipe crossings.

Recent Advances in Pipe Line Technology and Engineering. D. M. Taylor. *Pipe Line Ind. 12,* 43 (1960) Jan. (4 pp.)

Almost every phase of industry was improved during 1959, and there were several notable advancements. Most important were: Internal coatings proved out; spheroids found many uses; new low-cost gas-fired turbine is being made from jet aircraft engine; filmless X-rays of pipe; new high-pressure horsepower gas-fired turbine installed for unattended operation and jacket water is now being used to drive cooling fans.

Seismic Surveys on Pipeline Routes. M. J. Binckley and J. F. Stickel, Jr. *Proc. Pacific Coast Gas Assoc. 50,* 129 (1959) (4 pp.)

Description of one portion of the proposed Rock Springs Project to be constructed by Southern California Gas Co. and Southern Counties Gas Co. When the detailed location phase for the project was started, a relatively new application of seismic survey was investigated with the hope that more complete subsurface information might be obtained to aid pipeline design and to reduce construction costs. The program as proposed would be conducted by a two-man crew using equipment readily transported by hand. The equipment would be capable of fast ground coverage and exploration to depths of at least 20 ft. This program appeared to offer a way to obtain subsurface information within the limitation of available time and reasonable costs, and it was decided to become familiar with this new procedure by trying it at some rivers to be crossed by the proposed line. Results are discussed in article.

Pipeline Operations

Cleaning Internally Coated Lines after Construction and Testing. C. McClure. *Pipe Line Ind. 12,* 28 (1960) Jan. (4 pp.)

Use of a floating agent appears necessary to remove dirt and carry it ahead of the cleaning instrument to prevent scratching the surface. No amount of gas sweep will remove adhered particles of dirt ahead of the cleaning instrument. Tests show that a 1000-ft water column with up to 30 lb of detergent/1000 gal of water will effectively restore the glassy surface of the internally coated pipe. Scratches caused by the cleaning instrument breaking off weld icicles cannot be prevented.

Fly Your Line? R. S. Nabors. *Proc. Pacific Coast Gas Assoc. 50,* 143 (1959) (4 pp.)

Pacific Gas and Electric Co. has found that the aerial method of pipeline patrolling is very successful for their work for the following reasons: 1) Aerial survey has proven more adequate than vehicle and foot patrol combination; 2) it has provided a tool which insures uniform coverage, and 3) it has resulted in an appreciable monetary saving. Most important element in such a program is the pilot.

How to Use Pigging Method of Hydrostatic Testing for Distribution Lines. S. L. Reynolds. *Am. Gas J. 187,* 19 (1960) Jan. (9 pp.)

Follow-up of article which described some techniques employed by the Southern California Gas Co. to provide cost reduction in the hydrostatic testing of distribution trunk lines (see *Gas Abstracts 15,* 228). Current article offers a more specific discussion of theory and procedures involved in the actual testing. Article is complete with tables and illustrations that will serve as a guide for anyone with a desire to do their own hydrostatic testing.

Telemetering

Measurement and Communication Radio for Tele-Supervision of a Natural Gas Pipeline Grid. E. Harm. *Erdöl u. Kohle 12,* 837 (1959) Oct. (4 pp. German text.)

Radio telemetering system of the Neiderösterriechische Gasvertriebs AG of Vienna is described. The system uses five frequency pairs in the 80-, 160- and 7000 megacycle bands. A system map, block diagram and illustrations of the portable and station apparatus are given, with separate comments on the measuring, transmitting, alarm and central station circuits.

6. GAS AND LPG STORAGE

Underground Storage

Effect of Pressure and Temperature on Cavities in Salt. K. E. Brown and F. W. Jessen. *J. Petrol. Tech. 11,* (Tech. Paper 8097) 341 (1959) Dec. (5 pp.)

It is deemed feasible to store atomic reactor fuel wastes in salt dome cavities when the differential pressure acting on the cavity does not exceed 3000 psi and the temperature is less than 400° F. Tests at pressure increments of 1000 psi were conducted on a 2-in. cylindrical cavity contained in a 6-in. long by 6-in. diam

salt core. The cavity exhibited stability under pressures up to 3000 psi and temperatures to 300° F. At temperature ranges of 100-400° F and with pressures of 5000 psi and above continuous deformation of the cavity resulted. Initial movement of the salt was observed at all pressures. This was evidenced by vertical deformation and cavity size reduction.

Electric Reciprocating Compressor Powers Station at IPC's Gas-Storage Field. K. W. Robertson. *Oil Gas J. 58,* 73 (1960) Jan. 4 (3 pp.)

Freeburg compressor station of Illinois Power Co. has been completed to serve the company's Freeburg gas storage field. The station and field will supplement the gas supply to Belleville and East St. Louis, Ill., during days of high gas demand. When the gas demand is low, the plant will be used to pump gas into 31 gas storage wells in the Freeburg storage field. Initial installation at the station includes two 700-hp electric-motor-driven compressors, compressor auxiliaries, and a complete triethylene glycol natural-gas-deyhydration unit. A complete control system permits automatic operation of the compressor. Station horsepower will ultimately total 2800.

New Formations Under Galesville Storage Field Show Promise. J. D. Hammond. *Pipe Line News 31,* 47 (1959) Dec. (3 pp.)

During 1958, the Natural Gas Storage Co. began extensive testing of a new geological formation, the Mt. Simon, as a partial solution to an ever increasing demand for gas in the Chicago Metropolitan area. The Mt. Simon formation lies under Natural Gas Storage Co.'s present Galesville storage reservoir and is separated from the Galesville by a 600-ft-thick layer of impervious shale. Early in 1957, encouraged by the success of a pilot plant, Natural Gas filed with the Federal Power Commission a certificate to expand facilities at the Mt. Simon formation. In October of that year, the final well was tied in and injection was started as a full-scale operation at a rate of approximately 18-19 MMCF/day. To date, 3.5-4 billion CF have been injected at a pressure differential of 20 psi.

Methane Liquefaction

Automatic Purging of Liquid Methane Tanks. R. E. Sattler (assigned to Phillips Petroleum Co.) U.S. 2,916,889 (1959) Dec. 15.

In a storage tank for inflammable liquefied gas such as methane, a safety purging system is claimed in which a distributing manifold for carbon dioxide or nitrogen is fixed in the bottom zone of the main storage tank, said manifold connected to an outside pressurized source of the inert gas through a rupturable diaphragm or thermo-controlled valve which operates when vapor temperature within the main tank has risen to a given temperature.

Underground Storage

Underground Fluid Storage Containers. G. C. Harrison (assigned to Minnesota Mining and Manufacturing Co.) U.S. 2,914,923 (1959) Dec. 1.

In the underground cave storage of hydrocarbon gases, a process for stablization and sealing of a cave surface formation is claimed. The erodable granular rock surfaces are first stabilized by applying an aqueous dispersion of polymeric binder coagulant, such as polyacrylic acid, partially filling the interstitial granular spaces, then applying a hydrocarbon-insoluble sealing coat, such as polyalkylene polysulfide polymer (Thiokol) to fill the remaining interstitial space and to coagulate with the earlier binder.

7. MANUFACTURED GAS AND CHEMICAL PROCESSING

Acetylene

Acetylene Picture Is Clearing. M. J. P. Bogart. *Oil Gas J. 58,* 88 (1960) Jan. 4 (5 pp.)

Four commercially feasible methods currently exist that meet the stringent requirements of acetylene manufacture by the hydrocarbon synthesis routes: 1) Reaction in an apparatus where the energy input is supplied to a hydrocarbon stream by an electric arc. 2) Reaction in a regenerative furnace in a cyclic operation. Necessary thermal energy for the cracking reaction is supplied by burning a suitable fuel gas in a separate and previous portion of the furnace operating cycle. 3) Partial combustion which simultaneously conducts an exothermic reaction to balance out the endothermic requirements. An example is the combustion of a portion of the feed hydrocarbon with air or oxygen. 4) Flame chemistry, wherein the feed stock is injected into the hot combustion products of a fuel less valuable than the feed stock.

Coal Gasification

Gasification in a Slag Bath. R. Rummel. *Coke and Gas 21,* 492 (1959) Dec. (11 pp.)

After a short explanation of the process and a description of the construction and operation of a plant, built at the Union Rheinische Braunkohlen Kraftstoff A.G. in Wesseling for the production of 16,000 Nm^3 (600,000 CF at S.T.P.) of water gas/hr, and after an exposition of the present state of gasification in a slag bath, a theoretical investigation is presented which deals with the gasification characteristics of solid fuels with an air blast (production of low Btu gas) and with an oxygen/steam blast (water gas). This includes a statement of the average elementary composition and average calorific value of a great number of solid fuels of all types (from anthracite to wood and peat) as a function of the volatile matter ranging from 1-70%.

Production of City Gas by Low-Temperature Coking Gasification of Bituminous Coal in Tokyo and Freiburg (Breisgau). F. Domann and H. Schmitt. *Erdol u. Kohle 12,* 883 (1959) Nov. (8 pp. German text.)

Problem of city gas production from coal without also producing a coke residue has been solved technically in Tokyo and in Freiburg (Germany). This was achieved by use of the Gaz Integral process which is

based on the earlier Tully, Lewes and Strache processes of vertical shaft low-temperature coking of the weakly coking coals. In this method hot producer gas from the coked residue at the base of the shaft is forced upward through the incoming coal as a heating medium ("spulgas" or sweep gas process). Improved versions of the plant with oil carburetion have been in operation in Freiburg (two generators) and Tokyo (five generators) since 1957. Flow sheets, diagrams and operational data are discussed.

Hydrogenation

Kinetics of the Hydrogenation of Ethylene (on a Nickel Catalyst.) A. C. Pauls, E. W. Comings and J. M. Smith. *A.I.Ch.E. J. 5,* 453 (1959) Dec. (5 pp.)

Differential type of flow reactor, 0.25-in. I.D., was used to study the kinetics of the hydrogenation of ethylene on an alumina-supported nickel catalyst. This is apparently the first investigation made above atmospheric pressures. Data were obtained from 14.7-70 psi absolute and feed compositions from 40-90 mole % hydrogen. Measurements at temperatures from 30-80° C indicated an apparent activation energy of 11,600 cal/g-mole. The activity of the catalytic surface was reduced by exposure to ethylene or mixtures containing an excess of ethylene, owing to the formation of acetylene residues. Pretreatment of the catalyst at temperatures of 170° C with mixtures of ethylene and hydrogen stabilized the catalyst so that reliable rate data could be obtained. The rate measurements at 70° C were correlated by an equation. While the mechanism of the reaction cannot be determined from the data, the rate expression and other kinetic studies suggest a process in which hydrogen is adsorbed on the small fraction of the surface not occupied by acetylenic residues and the reaction occurs between this adsorbed hydrogen and ethylene in the gas phase.

Metallic Salts as Promoters in Hydrogenation with Platinum Oxide Catalysts. E. B. Maxted and S. Akhtar. *J. Chem. Soc.,* 3130 (1959) Nov. (4 pp.)

Effect of adding small quantities of various metallic chlorides to liquid-phase hydrogenation systems in the presence of platinum oxide catalysts has been studied. If this addition is made before the reduction of the platinum oxide to metal, promotion effects involving an increase in the hydrogenation rate up to over ten times its unpromoted value and a continuous hydrogenation path have been obtained for the reduction of valeraldehyde and acetone.

Inert Gases

Prepared Atmospheres in the Chemical Industry. A. H. Holden. *Chem. Process Eng. 40,* 388 (1959) Nov. (3 pp.)

Article discusses the production of purging, blanketing and process gases using standard or special generating units, with town gas, liquified petroleum gases, etc., as the raw material. Various uses of these gases in the chemical industry are mentioned. A summary of the accepted applications of protective atmospheres is tabulated and it is seen that the prevention of oxidation is now one of the most important. The usual sources of most protective atmospheres used in industry, when these are derived from generators, are the gaseous or liquid fuels which are readily available. Town gas is very commonly used as are the liquified petroleum gases propane and butane.

Oil Gas

Oil Gasification Plant in the Stockholm Gasworks. N. Fahlstrom. *Svenska Gasverks. Manadsblad 11,* 75 (1959) No. 11 (14 pp. Swedish text.)

Description is given of the new two-unit Segas plant for oil gasification at Stockholm, Sweden. This plant, built by Swedish constructors under supervision of the Power-Gas Corp., Ltd., engineers, has a capacity of 3.5 MMSCF/day of 490 Btu gas. The units, magnesite-lime catalyst, operating cycles and auxiliary equipment are discussed.

Oil Gasification

The Thermal Catalytic Otto-Tube Cracking Process for Production of City and Industrial Gases. K. Osterloh. *Erdöl u. Kohle 12,* 815 (1959) Oct. (4 pp. German text.)

Cracking gasification of light hydrocarbons in the Otto tube furnace is a technically simple and flexible method of supplying gas for utilities and synthetic uses. Conversion data, flow sheet and a list of sixteen plants are given.

Ore Reduction

Natural Gas Moves into Steel Making. R. A. Labine. *Chem. Eng. 66,* 50 (1959) Dec. 28 (4 pp.)

Proved commercially successful in a 200-ton/day plant, the HyL sponge iron process now claims the distinction of being the most fully developed of the current flock of direction reduction processes. The M. W. Kellogg Co. now is building an additional 500-ton/day sponge iron plant for Hojalata y Lamina—the process developer—in Monterrey, Mexico, and Premium Iron Ores recently announced plans to erect a 150,000-ton/yr HyL plant in Canada. In the present 200-ton/day plant in Monterrey, incoming natural gas is first preheated in one of two reforming furnaces, then passed through a desulfurizing drum. Returning to the furnace tubes, gas then reacts catalytically with steam to make hydrogen and carbon monoxide.

Synthesis Gas

Synthesis Gas Plant at Ijmuiden. A. P. van Amstel. *World Petrol. 30,* 50 (1959) Dec. (2 pp.)

Successful operation in Holland of Shell's first commercial gasification unit has led Mekog to plan installation of a second unit in its ammonia production facilities. Shell gasification process is based on the partial oxidation of a hydrocarbon feedstock in the presence of steam by oxygen, by air enriched with oxygen or by air, depending on the application. The reaction is a continuous noncatalytic flame type which takes place in a reactor

especially developed for the purpose. The reaction conditions can be readily adapted to the feedstock selected. The process is capable of converting any hydrocarbons from methane through light gasoline to residual oil. The main products of the reaction are carbon monoxide and hydrogen, together with minor quantities of carbon dioxide, methane, hydrogen sulfide and carbonyl sulfide, the last products being formed from the sulfur in the feedstock.

Coal Gasification

Process for Gasifying Fuels. R. Rummel. U. S. 2,913,321 (1959) Nov. 17.

In a pressure gasification process for particulate carbon fuels lower and upper chambers separated by a narrowed baffled partition are provided with tangential feed of coal and air-steam to the lower vessel, driving the product gas and fuel stream upward to the baffles which deflect the flow from the walls into a straight line vertical flow. The velocity of straight line flowing stream is reduced in the upper chamber to give completion of gasification.

Coal Hydrogenation

Coal Hydrogenation Process. J. H. Howell, E. W. Doughty and P. L. Alspaugh. U. S. 2,913,388 (1959) Nov. 17.

At least 10% by weight of coal is hydrogenated to a light oil fraction by operating at pressures (2000-2500 psi) lower than usual practice, using a tubular reactor to insure intimate rapid mixing of gas and liquid phases by high velocities through the multiple, heat-exchanged tubes.

Oxygen

Separation of Gas Mixtures. P. M. Schuftan and J. Neill (assigned to The British Oxygen Co. Ltd.) U. S. 2,915,880 (1959) Dec. 8.

In a gas liquefaction separation process, the compressed incoming gas mixture is divided into a major and a minor stream, the minor stream is further compressed, cooled to ambient temperature and condensible impurities removed, then the whole minor stream is expanded in a turbine and used to reheat part of the major stream which had been cooled by heat exchange with separation products. The minor stream thus partly condensed, is expanded and the condensate used to wash impurities from the remaining major stream. Both streams are rectified to product fractions. The amount used as minor stream is adjusted to balance the cold losses in the regenerator.

Separation of Air. P. M. Schuftan and A. D. Littlewood (assigned to The British Oxygen Co. Ltd.) U. S. 2,915,882 (1959) Dec. 8.

In this patent, when following the process of patent No. 2,915,880, the cooling of the compressed minor stream is accomplished by heat exchange with compressed pure liquid oxygen product, thereby vaporizing the pure oxygen to yield compressed gaseous oxygen.

Ore Reduction

Method and Apparatus for Handling Reducing Gases. J. C. Agarwal (assigned to U. S. Steel Corp.) U. S. 2,915,379 (1959) Dec. 1.

In a continuous direct reduction process for metal oxides, whereby the latter are treated in fluidized beds by high temperature and pressure reducing gas, the fresh gas at 20 atm pressure is used to drive a turbine which, in turn, repressurizes the regenerated spent gas from the reducing stages, to enable reuse of the spent gas blended with fresh gas at an intermediate pressure.

8. GAS DISTRIBUTION

Leakage

Mobile Infrared Gas Analyzer for Transmission Line Leakage Surveys. J. D. Brady. *Proc. Pacific Coast Gas Assoc. 50,* 139 (1959) (3 pp.)

Experience of the Southern California Gas Co. with the mobile infrared gas analyzer for leakage detection work is described. Unit was used on an experimental basis by both distribution and transmission departments to conduct surveys to determine usefulness of this instrument. From the beginning it appeared that the instrument is capable of detecting very small amounts of gas in a sample mixture. However, the problem of obtaining the sample and getting it to the instrument posed the greatest problem for application engineers in developing the instrument for pipeline work. Using the infrared analyzer mounted in a car or truck enables the survey of a line for leakage at the rate of 2-3 miles/hr, while a survey conducted using normal methods would require a day to cover the same distance.

Nitrous Oxide and Infrared Detector Supply Answer to Leak Problem. J. E. Kaufman. *Pipe Line Ind. 12,* 37 (1960) Jan. (4 pp.)

One answer to leakage detection during hydrostatic testing is to add N_2O to the test water and then run an infrared sniffer along the right-of-way. Even pinhole leaks will show up. Principle involved is simple: If a gas is released in the loose back fill it will rise to the surface of the ground. If a readily detectable gas is included in the test water, it can be pinpointed in the vicinity of the leak. If nitrous oxide is added to the test water, when the latter escapes, the so-called "laughing gas" rises to the surface; it can be detected in concentrations as low as 2 ppm and does not occur in nature.

Mains

A Pipe Within a Pipe. J. C. Fisher. *Gas Age 124,* 39 (1959) Dec. 10 (4 pp.)

Closed trench installation, made possible by using existing low pressure main as a carrier pipe for a new line, permitted work in congested areas with no serious traffic interference. Minimum group of construction equipment, elimination of excavating and carting

vehicles and a saving of nearly half a million dollars were other features of this unusual installation.

Construction Equipment for Company Crews. F. Messersmith. *Proc. Pacific Coast Gas Assoc. 50,* 122 (1959) (4 pp.)

Starting three years ago, the Southern Counties Gas Co. initiated a fresh approach to the problem of improving field operations of company crews by scheduled use of mechanical equipment. By the end of 1959 the combined direct savings resulting from the method described exceeded $100,000/yr. Hand labor has been greatly reduced and there is increased interest and convenience in the process of getting the job done.

Gas Main Extension. How We Do It in the San Diego Area. F. E. Edwards. *Proc. Pacific Coast Gas Assoc. 50,* 110 (1959) (2 pp.)

In an effort to gain better control of job scheduling and secure better customer relations through closer contact between departments of the company and the customer, the San Diego Gas and Electric Co. has developed a system that has proved highly effective. Service area is divided into small sections and each section assigned to a "Planner" charged with making contacts in his area. The nerve center of the entire operation is called the Customer Extension Planning Department whose prime function is to maintain up-to-the-minute progress records of all jobs moving through the company.

Gas Main Extension. How We Do It in Utah. C. F. Coleman. *Proc. Pacific Coast Gas Assoc. 50,* 114 (1959) (3 pp.)

Story of a main extension at the Mountain Fuel Supply Co. can be traced through three departments of the distribution division—new business, engineering and construction. The procedural routine for administrative and operating processing of the new job has been standardized, but the entire mechanism still is flexible enough to permit deviations when necessary. This flexibility is inherent in the organizational structure, but excellent inter and intra departmental coordination is the real key to successful and rapid handling of even the most complicated main extension.

Instrumentation for Safe Gas-Line Purging. H. M. Curtis and B. O. Cossey. *Proc. Pacific Coast Gas Assoc. 50,* 134 (1959) (6 pp.)

Purging gas lines, using a portion, or "slug", of an inert gas to prevent the formation of an explosive mixture, is a well established practice. Many technical reports and data have been published regarding purging practices. However, the existent literature includes few specific instructions showing how to actually set up and use the various recommended instruments for any given purge operation. Article attempts to provide this necessary information and is concerned with only two types of instruments — combustible gas indicators and portable gravitometers—and one type of purge operation, namely, into and out of service purging of pipelines using nitrogen as the inert "slug".

Odorization

Measurement for Control of Odor in Distribution. W. E. Churchill. *Gas Age 124,* 43 (1959) Dec. 10 (3 pp.)

Author believes there is a need for odormeters that contain both deodorized air and flow meters to minimize the effect of background odors and to act as a check against disorder in the instruments. To prove his point, he examines the development of the instrument through the years and comments upon its good and bad features.

The Odorisation of Town Gas. A. R. Myhill. *Gas J. 300,* 503 (1959) Dec. 16 (3 pp.)

Subject of gas odor now is assuming considerable importance in England because of the trend toward future practice to make and distribute increasing quantities of gas which, in its original form, is either odorless, or possesses only a faint smell, unlike that of town gas. Such gases include Lurgi gas, imported natural gas and those reformed from oil refineries.

Telemetering

Natural-Gas Dispatching Computer. B. Karcher and H. Jacobson. *Instruments & Control Systems 32,* 1824 (1959) Dec. (2 pp.)

Natural gas distribution for the Public Service Co. of Colorado system consists of 16 metering stations which may contain several orifice-type meters for gas flow measurements. Twelve stations are metered for purchasing, three stations measure gas consumed for steam generation and one station is metered for sale of gas. The computer system used will type out total hourly gas flow and 24-hr total gas flow for each of the 16 meter stations. It also will type out combinations of these data. The computer calculates every six minutes; the computation requires only 55 seconds. The circular-chart recorders have a 15-second period, and therefore will be the limiting factor if four or more recorders share a common transmission line.

9. GAS FUEL UTILIZATION AND APPLIANCES

Air Conditioning

The Small Free-Piston Engine Compressor. J. H. McNinch, W. W. Vogelhuber and R. J. McCrory. *Am. Gas J. 187,* 28 (1960) Jan. (3 pp.)

Article covers briefly the dynamic and power-generation aspects of a free-piston engine compressor intended for use in a residential air conditioning system (see also article on p. 4 of this issue). The requirements of low initial cost, high efficiency and compactness are met by the free-piston unit with its pneumatically operated fuel injection system. It is important to note that the unit was developed for a specific application; however, this does not necessarily limit the free-piston engine compressor to residential air conditioning. Changes would be required for other applications. This development program has shown

that the small free-piston unit has promise if designed to meet the specific requirements of its intended use.

Air Pollution

Coast's Largest Steel Plant Keeps Air Clean. Part 2. J. Smith. *Air Eng. 1,* 31 (1959) Dec. (4 pp.)

By July, 1957, all nine open hearth stacks at Kaiser Steel's Fontana, Calif., plant had been controlled by nine precipitators at a total cost of $5,500,000. At the plant, all raw materials are brought in in railroad cars. They are unloaded individually by two rotary dumpers. This operation created an air pollution problem which was solved by equipping the two dumpers with spray systems. Two new batteries of coke ovens are equipped with 180 self-sealing screw latch doors. The blast furnaces are equipped with dust catchers, gas washers and wet type precipitators. At the sinter plant, technicians are in the process of testing a wet scrubber, two types of baghouses and an electrostatic precipitator. The plant employs three oxygen steelmaking furnaces, and the pollution problem created by their use is being solved by three dry type electrostatic precipitators.

Flame Research

Burning Velocities of Mixtures of Hydrogen, Carbon Monoxide and Methane with Air. T. G. Scholte and P. B. Vaags. *Combustion and Flame 3,* 511 (1959) Dec. (14 pp.)

Burning velocities of mixtures of hydrogen-carbon monoxide, hydrogen-methane and carbon monoxide-methane with air were determined. These are maximum at a given gas/air ratio. The maximum burning velocities and the corresponding gas percentages are given as functions of the gas composition. The burning velocities of the various hydrogen-carbon monoxide-methane mixtures with air also were measured. The maximum burning velocities and the corresponding gas percentages of all hydrogen-carbon monoxide-methane mixtures are presented in a triangular diagram. Furthermore, a determination was made of the effect of smaller amounts of nitrogen, carbon dioxide and oxygen on the maximum burning velocity and on the corresponding gas percentage.

The Burning Velocity of Hydrogen-Air Mixtures and Mixtures of Some Hydrocarbons with Air. T. G. Scholte and P. B. Vaags. *Combustion and Flame 3,* 495 (1959) Dec. (7 pp.)

Apparatus is described by which the burning velocity of gas-air mixtures can be measured with an accuracy of about 5%. The apparatus has been used for measuring the burning velocity of hydrogen-air mixtures and mixtures of methane, ethane, propane, *n*-butane, acetylene, ethylene, propylene, and *n*-butylene with air as a function of the gas-air ratio.

Chemical Sampling Downstream of Lean, Flat Hydrogen and Propane Flames. (Tech. Note D-198.) B. D. Fine. (Washington: Nat. Aero. and Space Admin., Dec., 1959.)

Decay profiles were obtained for carbon monoxide and hydrogen downstream of lean, flat propane-oxygen and hydrogen-oxygen flames with nitrogen and argon as diluents. Slopes of decay profiles, obtained as a function of pressure, flame temperature, and burned gas composition, were related to time decay rates in the burned gas. The decay rates for hydrogen and carbon monoxide increased with the square root of the pressure and showed a small increase with temperature. Results suggested generally, but not conclusively, that the primary decay process was a recombination reaction involving molecular hydrogen and that decay of carbon monoxide occurred through water-gas equilibrium.

Considerations Pertaining to Spherical-Vessel Combustion. J. Grumer, E. B. Cook and T. A. Kubala. *Combustion and Flame 3,* 437 (1959) Dec. (10 pp.)

Certain considerations bearing on the interpretation of measured flame speed and pressure rise rates during combustion in a spherical vessel are treated. These include: 1) Relation of pressure rise and fraction of charge burnt; 2) development of experimental technique to determine approximate empirical values; 3) new burning velocity data and pressure dependence of the burning velocity, and 4) over-all thermochemical equilibrium in the burnt gas.

The Effect of External Factors on the Formation of Detonation in Saturated Knallgas-Steam Mixtures. L. B. Adler, E. C. Hobaica and J. A. Luker. *Combustion and Flame 3,* 481 (1959) Dec. (13 pp.)

Formation of detonation in saturated mixtures of knallgas and steam at 100° C was studied with respect to spark and hot-wire modes of ignition and geometry (diameter) of the reaction vessel. Reaction pressures and the amount of knallgas consumed by reaction in each experimental mixture were measured. The data indicate that the ease with which detonation is formed is affected by both of the primary variables in a dual manner which is strongly dependent upon heat and wall effects related to the reactor size. The controlling effects observed are apparently accentuated due to the "weak" nature of the pre-detonation reactions and the "slow" transition to detonation which are characteristic of the majority of saturated knallgas-steam mixtures.

On the Existence of Steady State Flames. A. L. Berlad and C. H. Yang. *Combustion and Flame 3,* 447 (1959) Dec. (6 pp.)

Examination of the adiabatic flame theories shows that the conditions, 'adiabatic' and 'steady state' imposed on the flame model are contradictory when a realistic reaction rate law is used. For the case of a freely propagating flame, only a quasi-steady state can be achieved, even though the 'adiabatic' condition is removed.

Flame Quenching in Converging Rectangular Channels. A. L. Berlad, R. D. Rowe and C. H. Yang. *Combustion and Flame 3,* 477 (1959) Dec. (4 pp.)

Converging rectangular channel flame quenching apparatus is described, suitable for use with a dynamic flame quenching technique which is stated to be particularly useful for high reactivity systems. The

application of apparatus and technique to the study of a stoichiometric oxygen-acetylene flame is outlined.

Further Measurements of Turbulence Intensity in Flame Zones. A. A. Westenberg and J. L. Rice. *Combustion and Flame 3,* 459 (1959) Dec. (7 pp.)

In a previous paper, a technique for measuring transverse turbulence intensity in flames by means of helium diffusion was described. Results were reported of the effect of various parameters on the intensity measured at a single location in highly turbulent flames stabilized on baffles in a 2- by 8-in. rectangular duct. This article contains additional results obtained at several other positions in the same duct. The data include heat release combustion efficiencies and turbulence intensities under both cold flow and burning conditions for each of two different values of approach flow turbulence intensity (approximately 5 and 10%). Premixed petane-air at an equivalence ratio of 0.7 and a pressure of 0.85 atm was used. The twofold increase in approach turbulence caused an approximately twofold increase in the rate of flame spreading. By comparing the absolute intensities of turbulence during burning and cold flow it is shown that in regions of actively burning gas the turbulence is higher than in cold flow, but in regions of completely burnt gas the intensity may be reduced and may even become laminar. Cold gas regions adjacent to flame zones are essentially unaffected by the presence of flame.

The Influence of Small Quantities of Hydrogen and Hydrogen Compounds on the Burning Velocity of Carbon Monoxide-Air Flames. T. G. Scholte and P. B. Vaags. *Combustion and Flame 3,* 503 (1959) Dec. (8 pp.)

Dependence of the burning velocity of carbon monoxide air mixtures on small admixed quantities of hydrogen, hydrogen compounds and deuterium has been measured. It was found that with carbon monoxide-hydrogen mixtures the square of burning velocity equals the sum of the square of the burning velocity of pure carbon monoxide and a term proportional to the hydrogen content. With added hydrogen compounds or deuterium a similar relation is valid.

Quenching Diameters of Some Fast Flames at Low Pressures. E. Anagnostou and A. E. Potter, Jr. *Combustion and Flame 3,* 453 (1959) Dec. (5 pp.)

Quenching diameters as a function of pressure have been presented for some fast stoichiometric hydrocarbon-oxygen and hydrogen-oxygen flames. The order of increasing ease of quenching is acetylene, ethylene, hydrogen, propane. The over-all reaction orders for all flames have been found to be very close to two.

Furnaces

Growth of Aircraft Firm in Step with Solutions to Difficult Heating Problems. C. Akins. *Ind. Heating 26,* 2474 (1959) Dec. (4 pp.)

Article is concerned with the design specifications and construction of a furnace for the precision testing and calibrating of certain ramjet engine accessories for the Marquardt Corp., Los Angeles. The furnace is a batch-type, natural gas facility and has a heating chamber that measures 6-in. high and 4-in. in diam.

How High Pressure Gas Atomizes Liquid Fuel in Open Hearth Firing. W. R. Gartz. *Ind. Gas 38,* 6 (1959) Dec. (3 pp.)

Mechanical properties to develop the flame pattern and direct it are obtained without dilution by inert material. As a result of the high thermal value of the gas and the lack of inert material, a higher flame temperature is attained with the use of natural gas. Some authorities claim that the gas-atomized flame temperature ranges between 100-200° F higher than the steam-atomized flame temperature. Use of high pressure gas for atomizing oil in open hearths includes these advantages: 1) Fuel cost savings; 2) steam cost savings; 3) air cost savings; 4) melting time reduction; 5) refractory life lengthened; 6) sulfur content of steel reduced and 7) saving on usable plant scrap.

Industrial Heating

Automatic Brazing Machine in Continuous Line for Assembling Heat Exchangers. N. L. Boisvert. *Ind. Heating 26,* 2442 (1959) Dec. (4 pp.)

Automatic, gas-fired brazing of tube return bends at the new Decatur, Ala., plant of the Air Conditioning and Refrigeration Division of Worthington Corp., is an integral process of an efficient production line for the assembly of 3-ton, 5-ton and 7½-ton heat exchangers.

Automatic Finishing of Fluorescent Light Fixtures in New Installation at Western Lighting Corp. R. C. Blair. *Ind. Heating 26,* 2515 (1959) Dec. (5 pp.)

With a major plant addition, Western Lighting Corp., Los Angeles, can directly control all phases of its manufacturing operation. In addition, orders can be serviced much more rapidly because of integrated production and increased production capacity provided by the finishing system. It essentially involves cleaning, drying, automatic electrostatic paint spraying and baking of varied styles of fluorescent light fixtures as they are moved by conveyor over a continuous path.

Improved Temperature Control in Drying Drum Prevents Scorching of Fabrics. *Ind. Heating 26,* 2524 (1959) Dec. (3 pp.)

Revolving drum is made particularly for drying printed fabrics or for heat-setting various synthetic coatings onto fabrics; however, many of its unusual design features would be applicable advantageously to other types of heated equipment in the textile industry. Ordinarily it operates at a surface temperature of 355-400° F, but it can maintain temperatures up to 700° F, as required by the process. The heat source is a gas-fired incandescent trough which generates heat.

Refining, Forming and Heat Treating Precious Metals at New Plant of Handy & Harman. *Ind. Heating 26,* 2466 (1959) Dec. (5 pp.)

Modern heating equipment is being used to process precious metals with exceptional economy in a new

plant recently opened at El Monte, Calif. In the refinement of metals, the plant uses a battery of four custom-built "dry pans"—to dehydrate sludges of gold, silver and platinum. Gold and silver refining also involves use of a gas-fired Bilt-Rite incinerator which has a 250-lb capacity, and a Mettler afterburner. Metals are further melted, refined and alloyed as necessary in the crucibles of one Hausfeld and two Fisher melting furnaces so that they can be cast in permanent metal molds. Either an electrically-heated Waltz unit or a Natural Gas Combustion furnace may be employed where controlled atmospheres are needed.

Specialised Gas Oven for Electrostatic Finishing. T. A. Dickinson. *Ind. Gas* (British) *22,* 13 (1959) Sept. (3 pp.)

Indirectly fired gas oven is efficiently serving a dual purpose in the electrostatic finishing of door frames for Ford automobiles at a new plant at Fullerton, Calif. Besides reducing losses of sprayed particles, this process permits complete automation of the finishing system and greatly accelerates the rate at which protective and decorative coatings can be satisfactorily applied.

World's Largest Tunnel Kiln Helps Cut Fuel Input 10%. E. K. Snidecor. *Ind. Gas 38,* 10 (1959) Dec. (3 pp.)

Gladding McBean's new vitrified clay pipe plant, Corona, Calif., finds natural gas ideal for "accurate time-temperature cycle" needed to insure high quality product. Each of the eight beehive kilns is equipped with 14 Schurs nozzle mix dual fuel (gas or oil) combination burners equally spaced around each circular kiln. Thus, firing can be accurately controlled during the cycle when temperatures up to 2100° F are reached. A complete, gas-fired combustion system has been installed with the tunnel kiln. The new kiln design, with 10 ft by 10 ft cars and the efficient combustion system, enables Gladding McBean to reduce its gas fuel input per ton of finished material by 10% compared to its other locations.

Ovens

Tests on a Travelling Type Dutch Baking Oven. *Ind. Gas* (British) *22,* 8 (1959) Sept. (4 pp.)

Article describes a series of tests conducted at Warder's Bakery, Ramsden Heath, Essex (England), with the object of obtaining information on the performance of the Econotype oven. Detailed tests were undertaken by the North Thames Gas Board and gas consumption and bread production were noted over a full working week.

Space Heating

Direct Heating of Large Industrial Buildings. F. S. Howard. *Gas J. 300,* (Gas in Ind. Sect.) 279 (1959) Dec. 2 (6 pp.)

Balance and trend of space heating in large industrial buildings has favored the installation of unit heaters, and this has been particularly the case in extensions to existing factories. The reasons for this have been: 1) High capital costs of central plant schemes; 2) shortage of money for capital investment; 3) flexibility of unit heater schemes; 4) extremely long delivery periods for central boiler plant, and 5) existing boiler plant and mains already overloaded to heat factory extensions.

Ovens

Apparatus for Convection Heating. F. O. Hess (assigned to Selas Corp. of America.) U.S. 2,917,299 (1959) Dec. 15.

Oven for convection heating is claimed in which a plurality of gas burners are arranged in the double-walled roof, with a fan in front of each burner to discharge hot products of combustion into the oven space to give any selected pattern in the heating operation.

Water Heaters

Temperature Control System for a Storage Water Heater. R. C. Bryce and F. Kahn. U.S. 2,913,182 (1959) Nov. 17.

Improved control of hot water temperature in a gas-fired storage water heater is claimed by the use of a combination of an emergency shut-off fuel valve responsive to the top tank water temperature, an upper cyclic thermostatically controlled valve also responsive to top temperatures and a lower cyclic thermostatic valve at the bottom of the tank. These valves, connected in the order above, maintain a predetermined top and bottom water temperature, after normal drawdown of water, with the emergency shut-off valve acting in case of excessive top temperatures.

10. EQUIPMENT AND INSTRUMENTATION

Computers

A Comparison of Integral and Incremental Digital Computers for Process Control Applications. E. L. Braun. *Control Eng. 7,* 113 (1960) Jan. (6 pp.)

Suitability of a digital computer for a particular control application depends on such factors as computation speed, logical and mathematical capabilities, input-output requirements, and reliability and maintainability. Integral and incremental computers each have inherent and distinctive design and operational features; these play a significant role in the evaluation of computer suitability.

Basic Techniques to Use in Simulating Plant Studies with Computers. D. A. Gibson and E. E. Ludwig. *Refining Eng. 32,* C-11 (1960) Jan. (7 pp.)

Brief discussion of the process, calculations, programming, convergence, and a summary of an application to an actual plant problem. Object is to present one example of how this type of problem was attacked and solved and to suggest that this may lend some insight into similar problems and their solution. Solution of the study and computer program required one man for

approximately four months, including calculation method analysis, programming and "debugging". Approximately three weeks then were utilized in running 30 cases involving various feed stocks and combinations of process equipment.

What to Look at When You Consider Integrated Computer Controls. M. Phister, Jr. *Refining Eng. 32,* C-21 (1960) Jan. (4 pp.)

Whether or not a computer is used in control of a process, certain simple control loops usually are installed to maintain processing conditions constant in the face of external disturbing variations. The latter include changes in raw material (chemical and physical properties), in ambient conditions (temperature of process air or cooling water), in process characteristics (catalyst, exchanger or fractionator efficiencies), in market conditions (raw or product value and production rate), equipment breakdowns, and surges. Set point adjustments of the control loops must be made by the operator or the computer for the most economic operation of the process. For computer control, the planning must include in sequence: Development of control equations, selection of measurement techniques, writing of the computer program, and installation. The objective equation must express the operating "profit" gained in the process as a function of process conditions. Operating relationships are developed which express product quality and flow as a function of the variables and a safety limit on the process must be set to restrict the control system. The author develops such a system with a fluid catalytic cracking unit.

Gaslights

Miniature Regulators for Gas Lights. G. Hughes. *Am. Gas J. 187,* 38 (1960) Jan. (2 pp.)

Case history of how one company met and solved problems in designing and producing miniature regulators for gaslight installations. To accomplish this they condensed all the features of a normal-size house regulator into a tiny space, then built a machine to automatically assemble and test the devices.

Temperature Measurement

Precision Thermometer System for the Liquid Helium Region. B. J. Sandlin and J. C. Thompson. *Rev. Sci. Instruments 30,* 659 (1959) Aug. (3 pp.)

High-precision thermometer system has been developed using a carbon resistor (Allen-Bradley type) as the sensing element. The resistor is in the frequency circuit of a stabilized Wien bridge oscillator. Thus temperature changes are displayed as frequency shifts. The frequency is read directly from a Hewlett-Packard type 523B counter. When operated in the neighborhood of 100 kc at 4.2° K the sensitivity is approximately 50 kc/deg. This corresponds to a temperature resolution of 20 μdeg, when used with the counter. Resolution can be improved by observing higher harmonics. The power input to the resistor is of the order of 10^{-2} μw. The time for a temperature measurement is 1 sec, and response time to changes are limited only by equilibrium in the thermometer. Absolute accuracy is essentially limited only by the determination of the helium vapor pressure during calibration.

Piping

Pipe Joint. A. E. Osburn. U.S. 2,914,345 (1959) Nov. 24.

Improved pipe joint is claimed comprising a coupling fitting having a socket therein, in which the pipe end can be inserted, a circumferential channel within said socket, and a molded elastic ring gasket of Y-shaped cross section in said channel, so that the foot of the Y fills the narrowed diameter of the channel due to its internally tapered wall, and the top of the Y abuts on an internal double shoulder. Once inserted, the pipe may not be withdrawn without heavy compression of the gasket.

Sleeve Joint with Resilient Spacing Means. A. Magnani (assigned to Establissement pour Materiaux de Construction.) U.S. 2,914,347 (1959) Nov. 24.

Sleeve-like pipe joint is claimed, in which O-rings of resilient packing material are retained in three seating grooves of rectangular cross section cut in the inner periphery. The two outer grooves retain the packings from displacement when the pipe ends are forced through them into the sleeve, and the middle groove serves to center the sleeve between the pipes whose ends seal against the middle O-ring.

Purification

Gas Treating Device. L. Silverman (assigned to Research-Cottrell, Inc.) U.S. 2,913,232 (1959) Nov. 17.

In an improved apparatus for purifying a gas stream by spraying with liquids, a special injection device is claimed which comprises a coaxial pipe connected with pressure-fed spray liquid supply, said pipe placed in the gas stream in a treating chamber, and perforated with a pattern of multiple orifices. The pipe is enclosed by a tubular sleeve, also perforated with orifices in a pattern to register with the openings of the spray pipe, said sleeve made to register the orifices intermittently by rotating the sleeve radially or reciprocating the sleeve longitudinally at a controlled rate.

11. MATERIALS OF CONSTRUCTION, AND CORROSION

Cathodic Protection

Field Evaluation of Cathodic Production of Casing. W. D. Greathouse, J. J. Lehman, J. E. Landers and J. D. Sudbury. *J. Petrol. Tech. 11,* (Tech. Paper 8099) 354 (1959) Dec. (7 pp.)

Full-scale field experiment on cathodic protection of casing answers questions concerning 1) the proper criteria for determining current requirements, 2) the amount of protection provided by different currents, and 3) the transfer of current at the base of the

surface pipe. Three dry holes in the Trico pool in Rooks County, Kansas, were selected for cathodic protection tests. The three holes were in an area where casing failures opposite the Dakota water sand often occur in less than a year. Examination of the electric logs showed the wells to be similar to other wells in the field where casing in four of seven producing wells has failed. This is the first concrete field evidence to help resolve the many arguments about the proper method for selecting adequate current for cathodic protection of oilwell casing.

The Permanent Anode in Impressed-Current Cathodic Protection Systems—Part 2. C. A. Curtis. *Corrosion Tech. 6,* 333 (1959) Nov. (3 pp.)

Progress continues in the search for better and more universal permanent anode materials in impressed-current cathodic protection systems. In Part 1 (see *Gas Abstracts 15,* 405) graphite, silicon iron and scrap steel were discussed in this connection and in this part the properties, uses and limitations of lead and platinized lead and platinized titanium are described. The fundamental principles of connection also are discussed.

Coatings

Efficient Pipe Handling Ups Output of Coating-Wrapping Plant. *Pipe Line News 31,* 54 (1959) Dec. (4 pp.)

Efficient pipe handling, from bare storage through processing and loading, is helping to boost production and quality control at the plant of Southern Pipe Coating Co., Atlanta, Ga. Only four years old, the modern facility has just experienced its third round of modernization and expansion to meet production demands of 45,000 ft of coated and wrapped pipe/8-hr day. More than a million feet are now processed per month.

A Laboratory Paint Test Program. R. E. Gackenbach. *Corrosion 16,* 1t (1960) Jan. (4 pp.)

Laboratory paint test program is described as a method of screening paints to select the specific item that will give the degree of protection needed for specific applications. Benefits and pitfalls of such a program are outlined. Paints that fail in the laboratory will probably fail in the field. Those that show promise in the laboratory must be field tested to determine final suitability.

Testing of Coal Tar Coatings (4) — Surface Preparation and Atmospheric Exposure. W. F. Fair, Jr. *Corrosion 16,* 5t (1960) Jan. (4 pp.)

Article discusses necessity of specifying non-bituminous inhibitory pigmented primers for all applications of coal tar protective coating systems. Tests are described in which selected primers and coal tar coatings were applied to coke plant areas subject to high atmospheric corrosivity. All systems applied to wire-brushed surfaces, primed or unprimed, failed within one year. The same systems on sandblasted surfaces, with and without primers, are still in satisfactory condition after five years' exposure in the same environment. Coated panels have been exposed for about four years at Ingleside, Texas, Kure Beach, N.C., and Kearny, N.J. Contrary to expectation, some coatings are weathering faster at Ingleside than at Kearny. Some non-bituminous systems which have already failed in Texas are still in satisfactory condition in New Jersey. Results to date confirm the advisability of specifying coal tar pitch emulsion as the best top coat for coal tar protective coating systems subject to atmospheric exposure.

Metals

Selection of Alloys for Refinery Processing Equipment. A. J. Freedman, G. F. Tisinai and E. S. Troscinski. *Corrosion 16,* 19t (1960) Jan. (7 pp.)

Variables in a refinery which affect selection of alloy materials to be used in construction of units are discussed. Examples are given of failures caused by lack of evaluation of alloys, in new processes before fabrication of units. Reasons are presented for establishment of a laboratory and pilot plant corrosion testing program along with an indication of the information on effects of temperature, concentration and time that should be obtained. Article also discusses metallurgical considerations which should be made in selection of alloys: Weld metal structure, grain boundary precipitation effects in stainless steels and in other alloys, problems in clad vessels, stress corrosion cracking in alloys and effects of hydrogen on alloys. Emphasis is given to the need of maintaining effective records of tests, chemical composition and heat treatment history of each specimen. Brief mention is made of the need to continue alloy evaluation by corrosion monitoring in process equipment.

12. ANALYTICAL METHODS AND TESTS

Aromatics

Low Voltage Mass Spectrometric Sensitivities of Aromatics. C. F. Crable, G. L. Kearns and M. S. Norris. *Anal. Chem. 32,* 13 (1960) Jan. (5 pp.)

Study of the mass spectral sensitivities of a number of aromatic compounds using low energy electrons has resulted in correlations useful for the prediction of low voltage sensitivities. The effects of substitution on an aromatic ring are evaluated for both hydrocarbon and nonhydrocarbon substitutions. These results permit sensitivities to be predicted for compounds not available for direct study.

Carbon

Gas-Proportional Counting of Carbon-14 and Tritium, and the Dry Combustion of Organic Compounds. D. R. Christman and C. M. Paul. *Anal. Chem. 32,* 131 (1960) Jan. (2 pp.)

Lower limit of activity detection and the precision with which it could be accomplished by gas-proportional counting have been discussed. Recently, an anti-coincidence counter of conventional design, made to operate with a ring of proportional counters and with two proportional sample counting chambers, has been

installed at Brookhaven (N.Y.) By this means both the precision and the lower limit of activity detection have been significantly improved. The unit is similar to those used for carbon-14 dating by gas-proportional counting, except that no mercury shield is employed.

Calorimetry

Low-Temperature Adiabatic Calorimeter with Automatic Shield Control. W. J. Cooper, R. H. Forsyth, J. F. Masi and R. E. Pabst. *Rev. Sci. Instruments 30,* 557 (1959) July (3 pp.)

Design and operation of an adiabatic low-temperature calorimeter employing a somewhat different design of automatic shield control is described. Thermocouple difference is sensed by a d-c μv amplifier, which is followed in the circuit by a recorder-controller and a Leeds & Northrup Series 60 (current adjusting type) control unit. The output of the latter is used to control the voltage across the shield heaters through a Westinghouse "Magamp" saturable reactor. This design has been used successfully with a conventional low-temperature adiabatic calorimeter (50-ml sample size). In most cases the recorder showed no variation from zero ($\pm 0.002°$) during heating and equilibrating periods, while momentary disturbance at "on" and "off" was less than 0.05°.

Chromatography

How Chromatography Can Improve Gasoline-Plant Profits. T. Mitchell. *Oil Gas J. 58,* 73 (1960) Jan. 11 (3 pp.)

Proper selection and application of chromatography can result in increased earnings to plant operators through better quality control and reduced operating costs. To help in determining the need for one of these analyzers in a given plant, some of the following applications should be considered: Analysis of finished product; control of fractionators to provide more stable operation, and better quality control of overhead and bottoms with less reflux; rapid analysis of absorber inlet and outlet gas to set optimum lean-oil rate; and analysis of flue gases to maintain more economical air-to-fuel ratios.

Gas Analysis

The Chemistry of the Upper Atmosphere. H. S. W. Massey. *Proc. Chem. Soc.,* 377 (1959) Dec. (8 pp.)

Work reported is concerned with the photochemistry of a nitrogen-oxygen mixture under low-pressure conditions in which photo-ionization as well as photodissociation plays an important part. Account also was taken of the presence of rare constituents, such as water vapor and its decomposition products, including particularly hydroxyl, oxides of carbon, methane and sodium. With the expanded use of rockets as vehicles to convey instruments to high altitudes and to carry out experiments described in the article, there will be a rapid accumulation of data which will help to clarify many issues. There will always be the need, however, for reliable quantitative information on the rates of reactions which are unusual, as far as the chemist is concerned, and occur strictly in the gas phase.

Nickel

Application of EDTA to Titrimetric Determination of Nickel in Nonferrous Alloys. V. A. Nelson and L. J. Wrangell. *Anal. Chem. 32,* 99 (1960) Jan. (5 pp.)

Method is described for the titrimetric determination of nickel in nonferrous alloys, using EDTA. Separation and purification of nickel are accomplished by double precipitation with dimethylglyoxime, thus eliminating the use of hydrogen sulfide for the removal of copper. Interferences caused by cobalt, iron and tin are avoided. Cal Ver 1 is the indicator chosen. The method has been applied to a wide variety of nonferrous alloy standards containing from 0.16-66.38% nickel. The 95% confidence limits for a single determination in the 0.16-0.60% range are $\pm$ 0.03%. In the 30.08-66.38% range they are $\pm$ 0.21%.

Oxygen

Automatic Recording of Dissolved Oxygen in Aqueous Systems Containing Surface Active Agents. K. H. Mancy and D. A. Okun. *Anal. Chem. 32,* 108 (1960) Jan. (7 pp.)

Polarographic method has been developed which permits continuous sampling, recirculation and automatic recording of dissolved oxygen in aeration processes. In this system the effect of various types of surface active agents on the electrode reaction kinetics has been studied. Surface adsorption of the surface active agents on the dropping mercury electrode interferes with dissolved oxygen determinations in the potential region of the first oxygen wave in the case of anionic compounds; cationic compounds interfere at the second oxygen wave; and in the case of nonionic compounds, interference occurs throughout the entire range of applied voltage. With anionic compounds dissolved oxygen determinations were made at an applied voltage corresponding to the second oxygen wave. With cationic compounds measurements were made at an applied voltage corresponding to the first oxygen wave.

Particle Size

Fluid-Catalyst Particle-Size Distribution Speeded by New Instrument. K. W. Brooks. *Oil Gas J. 57,* 70 (1959) Dec. 21 (2 pp.)

Manufactured by Sharples Corp., the Micromerograph is based on the application of Stokes' Law of Fall for the terminal velocity of particles falling through a gas. The instrument is being used by Standard of Indiana refineries and subsidiaries. Catalyst-particle size is critical in cracking operations, and this instrument furnishes a rapid, convenient method of determination.

Radioactivity Applications

Radioactive Isotopes, Still in Infancy, Are Saving Big Money. *Oil Gas J. 58,* 54 (1960) Jan. 4 (3 pp.)

Article outlines some of the ways companies use isotopes and how much they have saved in doing so. Fields of application are classified according to research and testing, refining, production and pipelining.

Sulfur

Rapid Determination of Hydrolyzable Sulfur in Organic Compounds. M. Wronski. *Anal. Chem. 32,* 133 (1960) Jan. (2 pp.)

Procedure used for tritration of sulfides with *o*-hydroxymercuribenzoic fluorescein as indicator can be applied to the determination of hydrolyzable sulfur in organic compounds. Hydrolyzable sulfur is defined as the sulfur that forms sulfide after boiling with *o*-hydroxymercuribenzoic acid. It has been stated that numerous bivalent sulfur-containing compounds undergo rapid hydrolysis when heated with *o*-hydroxymercuribenzoic acid in alkaline solution, which produces the sulfide complexes. The back-titration of unconsumed *o*-hydroxymercuribenzoic acid represents a simple method for the determination of hydrolyzable sulfur.

Carbon Monoxide

Apparatus for Detecting Carbon Monoxide. R. Valentine and H. G. Glover (assigned to Coal Industry ((Patents)) Ltd.) U. S. 2,916,358 (1959) Dec. 8.

Carbon monoxide detector is claimed in which the gas mixture passes through a brass heat exchanger coil, and then passes in the reverse direction through a ceramic tube placed axially within the coil. This tube contains first a chamber of inert granular material and second a similar chamber containing a granular oxidizing catalyst (Hopcalite). Thermistors are placed in each chamber and are connected into a resistance-bridge circuit to detect the presence of thermoelectric current from each chamber. A rise in temperature in the second (catalyst) chamber, caused by combustion of carbon monoxide, can be calibrated in terms of volume % of carbon monoxide.

Gas Analysis

Methods of and Means for the Estimation of Small Quantities of Gaseous Impurities in Rare Gases. J. Dunderdale and A. H. Cockett (assigned to The British Oxygen Co. Ltd.) U. S. 2,916,693 (1959) Dec. 8.

Means for estimating traces of gaseous impurities in rare gas is claimed, which comprises an electrical discharge tube, through which the gases are pumped at low pressure. Traces of nitrogen, air, CO_2 or methane in argon or helium increase the brilliance of the discharge color, which may be measured photoelectrically on a previously calibrated scale.

13. BASIC SCIENCE

Catalysis

Solid-Catalyzed Reaction in a Fluidized Bed. W. K. Lewis, E. R. Gilliland and W. Glass. *A.I.Ch.E. J. 5,* 419 (1959) Dec (8 pp.)

Results are presented for the solid-catalyzed hydrogenation of ethylene in fixed and fluidized beds. The effect of gas velocity, bed height, catalyst activity, particle size, and internal baffles on fluidized reactor efficiency are given, and equations derived from a simplified mathematical model correlate the data.

Chemisorption

Dissociative Adsorption of Hydrocarbons on a Supported Nickel Adsorbent. A. K. Galwey and C. Kemball. *Trans. Faraday Soc. 55,* 1959 (1959) Nov. (11 pp.)

Method of determination of the composition of hydrocarbon radicals dissociatively chemisorbed on a reduce nickel surface is described. The extent to which this reaction, C_xH_y + metal surface C_xH_{y-n} (adsorbed) + n H (adsorbed), occurred was directly measured by the exchange of the adsorbed hydrogen atoms with gaseous deuterium, mixtures being analyzed using a thermal conductivity gauge. This reaction was studied for the chemisorption of isomers of pentane and hexane at various temperatures and it was found that little or no dissociation occurred at 0° C or below, adsorption being almost entirely physical. At higher temperatures a limiting number of hydrogen atoms/molecule became exchangeable; this limiting value (shown in brackets) was determined for the following compounds: *n*-pentane (5); *iso*pentane (5); cyclohexane (4) and 2:3-dimethylbutane (4). Results showed that the radicals formed by extensive dissociative adsorption were only removed from the surface under relatively forcing conditions, usually accompanied by secondary reactions. Structures for the adsorbed radicals are proposed.

Fluid Flow

Chemical Reaction in the Laminar Boundary Layer—Instantaneous Reaction. O. E. Potter. *Trans. Instn. Chem. Engrs. 36,* 415 (1958) Dec. (7 pp.); (From *Appl. Mech. Rev. 12,* 862 (1959) Dec.)

In absorption and extraction processes, the rate of transfer of mass is determined by the concentration gradients and diffusion coefficients. The combined effects are described by a mass transfer coefficient often also known as the "true" mass transfer coefficient. If mass transfer is accompanied by chemical reaction, the effect of the reaction is to increase the concentration gradients and hence the rate of mass transfer. Such systems have been analyzed previously by Hatta, Danckwerts, and Sherwood and Pigford for conditions of rest or uniform motion. Paper abstract considers the addition effect of nonuniform flow in a viscous boundary layer is considered. It is found that under boundary-layer conditions the ratio of the apparent and true mass transfer coefficients may be larger or smaller than the ratios obtained previously depending on whet $D_A/D_B > 1$ or < 1, respectively (D_A and D_B are diffusion coefficients for species A ((wall)) and B ((stream)), respectively). For some cases considered the changes are of the order of 20% and are significant. This additional effect is due to the effect of nonuniform flow on the concentration gradient. In the present treatment, the effects of the transfer of mass and the heat of reaction on the velocity distribution in the boundary layer were neglected.

Y.-H. Pao, USA

Void Fractions in Two-Phase Flow. H. S. Isbin, H. A. Rodriguez, H. C. Larson and B. D. Pattie. *A.I.Ch.E. J. 5,* 427 (1959) Dec. (6 pp.)

Void fractions (fraction of the flow cross-sectional area occupied by the gas phase) have been measured for steam-water flows in an adiabatic, horizontal test section of 0.484 in. I.D. at 400, 600, 800 and 1000 psi gauge. A comprehensive survey of void data for two-phase concurrent flow is included in the paper, and the data, including the Martinelli and homogeneous flow model predictions, are compared. System characteristics, involving one- and two-component flows in horizontal and vertical test sections with and without heat transfer over a range of flow ratios, total flow rates, and pressure, are too complex, and the data available are neither extensive nor precise enough to warrant the generation of over-all correlations. Use of the void data in correlating two-phase frictional pressure drops is discussed. A model has been prepared for the prediction of critical flows based upon the void data, and calculations have been made for steam-water critical flows over a range of critical pressures from 15-2000 psi absolute.

Fluidization

Fluidized-Bed Reactor Studies. W. G. May. *Chem. Eng. Progress 55,* 49 (1959) Dec. (8 pp.)

Tracers used to evaluate gas-solids contacting, and the mathematical model developed for use in experiments and applications to chemical reaction results are discussed. Scaling-up reaction results from small to large size fluid beds is an important and difficult problem. The flow behavior in large units differs from that in small units substantially. In some cases the difference has been so large as to render the large units practically inoperable. An experimental approach to this problem is presented.

Heat Transfer

Heat and Mass Transfer. E. R. G. Eckert and R. M. Drake, Jr. (New York: McGraw Hill Book Company, Inc., 1959) 530 pp.; $12.50.

In the lapse between the publication of the first and second editions, the author's fundamental goal has not changed; the current work represents an expansion of information on the subject. The text discusses all phases of heat transfer and is applicable to the classroom because of its presentation and meticulous reference to source material. Under conduction, the author discusses basic balances for steady and unsteady state, isotropic and anisotropic materials. The treatment of convection starts with the thermal and momentum boundary layers, the Karman-Prandtl velocity profile, laminar boundary layer equations, flow in tubes and flow about objects. An interesting section treats recent developments in the description of turbulence involving the eddy diffusivity concept. More emphasis is placed on flow with separation than in most texts. A chapter is devoted to new processes and problems such as high velocity flow between plates, and transfer within gases at high velocities, transfer in rareified gases and liquid metals, and transpiration cooling. Other sections are devoted to free convection, condensation, evaporation, thermal radiation and to mass transfer with consideration of combined mass and heat transfer for the laminar boundary layer and similarity relations. The text closes with a chapter on heat exchanger calculations.

Heat Transfer by Radiation through Porous Insulations. B. K. Larkin and S. W. Churchill. *A.I.Ch.E. J. 5,* 476 (1959) Dec. (8 pp)

Radiant transfer through fibrous and foamed insulating materials was investigated theoretically and experimentally. Transmission measurements were made under isothermal conditions with a black-body source varying from 200-800° F. Bulk density and fiber and pore size also were varied. These data were interpreted successfully in terms of a simple theoretical model. The results provide design information and define the contributions of the several mechanisms of transfer.

Influence of the Presence of Vapor Diffusion from a Wetted Non-Adiabatic Boundary upon the Sensible Heat Transfer between a Boundary Wall and a Gas Stream. C P. Hedlin and F. C. Hooper. *Can. J. Chem. Eng. 37,* 208 (1959) Dec. (4 pp.)

Experimental equipment was devised to measure the sensible heat transfer coefficients at the inside surface of a porous ceramic tube from which water was being evaporated. Series of tests were conducted for non-adiabatic wall conditions over ranges of the Reynolds number from 5600-16,000, tube diameter from 1.360-3.300 in., bulk air temperature from 150-220° F, and wall vapor pressures from 0.35-2.20 psia. Over the range of vapor pressures and evaporation rates investigated, the sensible heat transfer coefficients were not observed to depart significantly from those predicted by generally accepted relationships for the dry wall case.

High Temperatures

The Plasma Jet and Its Uses. M. L. Thorpe. *Research/Development 11,* 5 (1960) Jan. (8 pp.)

Plasma jet is an arc-gas device capable of heating gas to extremely high temperatures. No combustion is involved. An electric arc is contained within a small tube through which gas also is blown. The gas issues from the device and resembles an open welding flame. Gas temperatures are not limited by internal heats of reaction since no combustion takes place. By adding electrical energy continually, the device can develop gas temperatures in the range of 30,000° F with some gases. Hydrocarbon oxygen flame temperatures, on the other hand, are limited to approximately 5600° F. Gas stabilized types of plasma torches are represented in the following basic designs: Vortex; gas sheath; wall, and magnetic.

Hydrogen Sulfide

The Carbon Dioxide-Hydrogen Sulphide-Methane System. Part 2. Phase Behavior at 40° F and 160° F. D. B. Robinson, A. P. Lorenzo and C. A. Macrygeorgos. *Can. J. Chem. Eng. 37,* 212 (1959) Dec. (6 pp.)

Phase behavior of the carbon dioxide-hydrogen sulfide-methane system has been investigated at pressures of 400, 1000 and 1600 psi absolute at 40° F and at 160° F. Correlation of the experimental data is based upon equilibrium ratios calculated for the individual com-

ponents. Equilibrium ratios were found to be a function of system composition, temperature and pressure. Deviation of the liquid phase from ideal solution behavior, as indicated by calculated activity coefficient ratios, is, in general, most dependent upon system composition at the higher pressures and lower temperatures.

Heterogeneous Phase Equilibria of the Hydrogen Sulfide-Carbon Dioxide System. D. P. Sobocinski and F. Kurata. *A.I.Ch.E. J. 5,* 545 (1959) Dec. (7 pp.)

Experimental study of the system hydrogen sulfide-carbon dioxide was performed from the critical region to the solid-liquid-vapor region. For seven mixtures individual phase diagrams were determined by the establishment of dew, volume percentage, liquid, bubble, critical and triple points. A splendid study of this system had been reported earlier by Bierlein and Kay for temperatures above 32° F. However, from a temperature point of view this earlier work represents about one-half of the phase diagram from the critical locus to the locus of triple points. Hence in this study particular attention was devoted to the lower temperature regions. Equilibrium constants were determined from 100-1200 psi absolute. Vapor and liquid equilibrium compositions from this investigation were compared with those obtained by Bierlein and Kay at 20, 40, 60 and 80 atm. Solid-liquid-vapor loci were found to meet at a minimum temperature, lower than either of the individual pure component triple points, due to the formation of a eutectic mixture consisting of 12.5 mole % carbon dioxide. Vapor and liquid compositions in equilibrium with solid were established along the vapor-liquid-solid carbon dioxide and vapor-liquid-solid hydrogen sulfide loci.

Kinetics

Transport Properties of High-Temperature Multicomponent Gas Mixtures. E. A. Mason, J. T. Vanderslice and J. M. Yos. *Phys. of Fluids 2,* 688 (1959) Nov.-Dec. (6 pp.)

Investigation is made of some modification in the kinetic theory of gaseous transport properties which are necessary to take account of effects encountered at high temperatures. In particular, complications arise because of the existence of a multiplicity of different interaction energy curves governing collisions, and because of the possibility of resonant excitation and charge exchange during collisions. It is shown that the results of classical kinetic theory can be kept in the same form, but the cross sections or collision integrals have to be computed differently. It is pointed out that the present modifications are valid to all orders of Chapman-Enskog approximation. It is also shown that excitation exchange is important in determining the transport properties of mixtures at high temperatures, and the method of calculation of the excitation exchange probability is extended to cases for which multiple interaction curves are involved.

Mass Transfer

Transfer Resistance and Fluid Mechanics. R. J. McCarter and L. F. Stutzman. *A.I.Ch.E. J. 5,* 502 (1959) Dec. (4 pp.)

Pure liquids were evaporated in a wetted-wall column into flowing streams of air to investigate the thickness and transfer resistance of gas films. It was found necessary to express Reynolds number relative to the liquid surface to correlate transfer with gas flow. Laminar and buffer layers in the gas phase were calculated from fluid-flow principles and compared to the effective film thickness calculated from mass transfer and molecular diffusivity. Good agreement was obtained, indicating applicability of fluid mechanics to mass transfer problems. Eddy diffusivity was indicated to have a negligible effect upon the total resistance to transfer.

Vaporization

Evaporation Rates of Liquids to Flowing Gas Streams. D. E. Severson, A. J. Madden and E. L. Piret. *A.I.Ch.E. J. 5,* 413 (1959) Dec. (6 pp.)

Influence of high concentration gradients and high evaporative velocities on rates of mass transfer was studied by evaporating liquids into low-speed inert gas streams at pressures approaching the vapor pressure of the liquids. Inert gas concentration in some experiments changed nearly fivefold across the boundary layer. The velocity normal to the surface (owing to evaporation), usually neglected in comparison with main-stream velocity, varied from 0.038-19 times the main-stream velocity. The data for air-water, air-carbon tetrachloride, air-chlorobenzene, and helium-chlorobenzene systems were represented within experimental error over the Graetz number range of 0.1-1800 by the flat-duct equation of Butler and Plewes and also by the usual dimensionless plots.

Water

The Enthalpy of Water in the Liquid State. R. Byrne and G. Thodos. *A.I.Ch.E. J. 5,* 551 (1959) Dec. (5 pp.)

Enthalpy of water in the liquid state has been calculated from 32° F to temperatures approaching the critical and pressures ranging from saturated conditions to 160,000 psi absolute. The graphed results show the significant influence of pressure on enthalpy, particularly in the lower temperature region. At these conditions pressure is found to increase the enthalpy of liquid water by as much as 360 Btu/lb above the corresponding enthalpy of the saturated liquid state. A literature search disclosed PVT data for water that permitted the construction of a density correlation. This correlation expressed in reduced coordinates extends from the normal freezing point of water to temperatures of 1870° F (T_R = 2.0) and pressures ranging up to 10,915 atm (P_R = 50). The recent extensive PVT data of Kennedy (1950) supplemented by Amagat and Bridgman allowed the calculation of enthalpies at these elevated temperatures and pressures. For these calculations basic thermodynamic relationships were adapted which utilized this reduced density correlation and thus permitted the extension of the thermodynamic properties of liquid water above the highest pressure reported by Keenan and Keyes. Below 6000 psi absolute, good agreement was found to exist between the enthalpy values presented by Keenan and Keyes and those reported in this investigation.

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American Chemical Society, Journal of
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American Institute of Chemical Engineers, Journal of
American Petroleum Institute Quarterly
American Society for Testing Materials Bulletin
Analytical Chemistry
Appliance Manufacturer
Applied Chemistry, Journal of
Applied Mechanics, Journal of
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Applied Physics, Journal of
Applied Spectroscopy
ARS Journal
ASHRAE J.
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Australian Journal of Chemistry
Basic Engineering, Journal of
Battelle Technical Review
Bituminous Coal Research
Brennstoff-Chemie (German)
British Coal Utilization Research Association Monthly Bulletin and Quarterly Gazette
Business Week
Butane-Propane News
California Oil World
Canadian Chemical Processing
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Institute of Petroleum, Journal of (British)
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LP-Gas
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Scientific Instruments, Journal of (British)
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